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Outlook for data-related business opportunities within the Finnish energy industry

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Abstract

Looking for uses for data related to electricity consumption has been a hot subject within the Finnish energy industry for some time. People have wondered whether data could be of benefit but, more notably, there has been a lack of a consistent approach to comprehend data utilization opportunities. This study attempts to create this desired peace of mind by creating an outlook for how data utilization opportunities should be approached. Fourteen experts representing the industry were interviewed during the process.

It is found that the current industry setting is different to what utilizing data presumes. For example, priorities of distribution system operators appear to be in assuring seamless operations, not in exploring advanced data-related ideas. On electricity retailing, it is found that data utilization ideas do not work in a vacuum. Following that, an argument regarding electricity retailers to strive to change the industry configuration to a more advantageous state for them and for utilizing data is explored. On Datahub, the upcoming central industry information system, it appears that benefiting from it will be difficult. It is further elaborated how its design ideals define what kind of data utilization related opportunities there can possibly exist. However, one visionary idea to Datahub would be to let it serve data related to demand response potential in an automatic fashion.

The study builds on a detailed illustration of the industry and its main actors after Datahub has been taken into use. Surprisingly, also this partial result appears to be fresh because previous publications have not shown similar interest for energy industry actor details. The study's process of seeking to understand a subject wholely and looking at opportunities through aspects limiting them might be useful as an analysis tool in the future.

Keywords opportunities, data utilization, energy industry, value networks, resource-based theory, information systems, power consumption data, datahub

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Tiivistelmä

Sähkönkäyttöön liittyvän tiedon hyödyntämismahdollisuudet ovat olleet jo jonkin aikaa kuuma aihe Suomen energiateollisuudessa. Ihmiset ovat pohtineet sitä, että onko datasta hyötyä. Mutta merkittävämpää on se, että lähestymistapaa datamahdollisuuksien ymmärtämiseen ei ole ollut olemassa. Tutkimuksen tarkoituksena on tarjota tuo lähestymistapa ja näkymä datankäytön mahdollisuuksiin, ja siten rauhoittaa ajatuksia. Tutkimus perustuu neljääntoista asiantuntijahaastatteluun.

Tutkimuksessa löydettiin, että energiateollisuus on yleisesti erilaisessa tilassa kuin mitä datankäyttö edellyttää. Esimerkiksi jakeluverkonhaltijoiden prioriteetit liittyvät ennemminkin sujuvaan käytännön toimintaan kuin edistyneeseen datankäyttöön. Sähkön vähittäismyynnin tapauksessa datankäyttöideat eivät näyttäisi toimivan itsekseen kuin tyhjiössä. Tähän perustuen tutkitaan väitettä, että sähkön vähittäismyyjien pitäisi pyrkiä muuttamaan teollisuuden rakennetta itselleen ja datankäytölle suotuisammaksi. Toisaalta energiateollisuuden tietovirtoja tulevaisuudessa yhdistävän Datahubin hyödyntäminen muuhun kuin sen oletuskäyttötarkoitukseen vaikuttaa vaikealta. Tätä pidemmälle pohdittaessa päädytään ajattelemaan, että Datahubin suunnittelulähtökohdat määräävät sen, millaisia tiedonkäyttömahdollisuuksia Datahubiin liittyen voi ylipäätänsä olla olemassa. Kuitenkin yksi visionäärinen Datahub-idea on, että se voisi automaattisesti tarjota kulutusjoustopotentiaaliin liittyvää tietoa.

Tutkimus rakentuu yksityiskohtaiselle kuvalle energiateollisuudesta ja sen toimijoista Datahubin ollessa toiminnassa. Yllättävästi myös tämä osatulos vaikuttaa tuoreelta, koska aiemmissa julkaisuissa ei ole ollut samanlaista kiinnostusta alan toimijoiden yksityiskohtien läpikäyntiin. Tutkimuksessa käytetty prosessi, jossa lähtökohtana on hyvä ymmärrys ja jossa mahdollisuuksia katsotaan niitä rajoittavien tekijöiden kautta, voi tulevaisuudessa olla hyödyllinen analyysityökaluna.

Avainsanat liiketoimintamahdollisuudet, tiedon hyödyntäminen, datan käyttö, energiateollisuus, arvoverkot, resurssipohjainen teoria, tietojärjestelmät, sähkönkulutustieto, datahub

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Iikka Airaksinen 17.5.2017

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1. Introduction

Analyses of industry dynamics, of business configurations, and attempts to find a purpose for data are some hot topics in the academic business literature (e.g. Ceretta et al., 2016). Within the next few years there will be a unique opportunity to take these subjects into practice in the Finnish energy industry. The study denotes with the term energy industry the portion of it dealing with electricity, its distribution and sales. The industry will have its current point-to-point information transfer structure reformed with a new central system (Fingrid Oyj, 2015). Datahub, as it is called, will collect and serve data about electricity consumption and related contracts, including details such as the manner and the location of consumption. Mainly, its purpose is to facilitate information transfer between energy retailers and regional distribution system operators (DSO) (Fingrid Datahub, 2016).

As it turns out, industry efforts to date have focused on making Datahub and its basic features a reality. But what should be right behind the horizon is to wonder what kind of new business opportunities, inspired by Datahub, are available in the new industry configuration. One open question has been whether industry data could be utilized to some larger extent, perhaps even beyond the borders of the energy industry itself (Lindholm, 2016). On the other hand, advancements such as Datahub drive information system restructuration within individual actors, making an inspection of the status quo and imagining possible future directions a desirable research target.

Considering the setting from an academic point of view makes the setup and the target industry look that much more interesting. Existing energy industry research, at least some of the Finnish samples, have been limited to using SWOT[1] analyses in their deductions. The popularity of the SWOT schema, for example, can be explained by that the papers have been meant primarily for an industry insider audience, not an academic community. This creates demand for a study that includes a heavier theoretical basis, seeking to bring in insights from past literature into the prevalent thinking within the industry.

A resource-based theory (RBT) perspective offers quite a good fit and a foundation to build on for that need vis-à-vis the existing industry structure (Barney, 1991; Wernerfelt, 1984). The specific industry at hand has an established structure and, on the other hand, to make sense of data utilization possibilities details need to be studied. To simplify the industry actors into some collections of resources, whatever they are, is an intriguing but also a natural choice. A disciple of the RBT should also possess quite many degrees of freedom as the resources can be defined to be whatever suits the purpose the best. For example, they can be some classic concepts or something fancier such as dynamic capabilities (Teece et al., 1997) or core competencies (Prahalad and Hamel, 2006).

1 The birth of this widely used term for Strengths, Weaknesses, Opportunities and Threats, as proven by over 600000 Google Scholar results, is unclear and cannot be attributed to a single research outcome.

But those are not all of the RBT's qualities. Any apparent flaws of the RBT seem to be limited, for example, the industry does not exactly appear very turbulent or the resources very mobile (Amit and Zott, 2001). Moreover, the study strives to utilize the RBT in an effort to see the firms within the industry in all their colors, not as a definite industry dynamics analysis tool. For the latter purpose, the study extends the RBT literature with that of value networks and identifies themes that explain or bring together industry actor behavior (e.g. Lusch et al., 2010). Simply put, notions of RBT and value networks are to condense and to comprehend the industry's and its actors' current state and assumed short term future.

Then, the most theoretically interesting part remains, that how to comprehend or to seek out some future business opportunities. Modelling the landscape of the energy industry can be said to have been characterized by sayings *what is* and *what will be*. On the other side of the coin, there is the second part, of the outlook for business opportunities, which goes along saying of *what can be*. This is a space with more liberties and, hence, of more contention in literature, leading to questions related to the viability and the manner of conduct of a study. How to assure any kind of comprehensiveness for a study when you do not really know what you are looking for? After making one, how to assess the certainty, or the likelihood, of being correct or that the study is even relevant to the matter? Considering business opportunities as a notion, exemplifying a way to understand them should be academically interesting.

What puts the study on the right trajectory regarding opportunities is that they are not systematically searched for (Ardichvili et al., 2003, pp.114-115). Sarasvathy and Dew (2005) explain that a certain realization process for a new market has to involve various stakeholders and their commitments to the process, shaping the outcome, but there is no actual requirement for any specific opportunity. They even argue consumers' ill-defined wants in general do not have much influence on such a process (Sarasvathy and Dew, 2005, p.559). The study defines opportunities as possible beneficial value network reconfigurations sometimes requiring a "trigger", making the process leading to their exploitation more of a reactive activity. The kind of a definition of opportunities above all brings finiteness to the listed questions and alike.

At this point, the study's research problem can be formulated to create an outlook for business opportunities bearing relevance to data utilization within the Finnish energy industry, as shown on the next page. However, what this means is that identifying aspects that create flexibility and additional options, to remove barriers so to say, for the actors involved is central to the study rather than the formulation of any actual new business plans. The study seeks to create an understanding of what kind of aspects there are limiting data utilization endeavours within the industry. Specifically, this is achieved through modelling the industry value network, modelling individual industry actors as certain resource configurations, spotting themes underlying opportunities, and last drawing some areas where there may be future activity.

The research problem:

- What is the outlook for business opportunities loosely related to data utilization within the Finnish energy industry?

Individual research questions:

1. What is the industry's main value network and what kind of resource configurations are its individual actors composed of? That is, what is the lay of the land of the industry and its actors? What kind of future for the industry is to be expected on a larger scale?

2. What kind of themes underlying data utilization opportunities are there for each elaborated actor? That is, what are the current states of data utilization efforts, the desired future states, and the barriers inbetween in actor-specific use cases deduced from their resource configurations?

3. What is the industry outlook for data utilization business opportunities? That is, what kind of an estimation of opportunities can be attained by considering the extent of existing barriers? Are there regions that look promising from a data utilization perspective? What can be said of incentives to develop these regions?

Notably, it is found that there may be evolvements within electricity retailing and, on the other hand, there could be more to arranging the DSO operations as efficiently as possible. A few exact data utilization targets were located, such as that there could be more to simply harnessing thin-paced consumption timeseries for diagnostics. If looking at a bit further future the study offers its own take on the often discussed about demand response arrangements. Even though the idea of an automated demand response system may be a bit utopistic, it is certain the direction of movement is towards that kind of future in general. The power grid input fluctuating more heavily in the future due to, e.g., an increasing number of solar panels, sees that there is a desire to see some larger demand response system in existence.

The study is structured to begin with a literature review on industry and its actor dynamics theory rather than a large mass of data analysis papers as reasoned above. It is, however, confirmed that the topic of energy industry data utilization is interesting on a global scale, that no exhaustive amount of research has been done on it. In fact, the topic is found to be very fresh. After that the study goes through its interviews-based method and displays its findings in two portions, one for the whole industry and the other arranged per industry actor. The study concludes in the usual way with a few thoughts on the findings, its limitations, and propositions for future research.

2. Literature review

2.1 Conceptual background of the study

2.1.1 Definition of the Resource-Based Theory and the premise of the study

An early incarnation term "resource-based view" was coined by Wernerfelt (1984) in an abstract article in 1984. Seven years and numerous articles later from as many authors (to name a few, Winter and Nelson (1982), Rumelt and Lamb (1984), and Dierick and Cool (1989)) Barney (1991) tied the various findings together to form the basis for the resource-based theory (RBT). Academically speaking, this kind of a theorizing process was quite ideal, a systematic revealing of knowledge fragments leading to a construction of a full theory. But as it turned out, the theory has got its fair share of contesting over the years.

The resource-based theory as presented by Barney in 1991 was built on a few core concepts, which I break into several parts below with a motivation to highlight its problems. Of those, the sustained competitive advantage concept forcefully attached to the RBT may be the most problematic. The problem is that a firm is assumed to have to be active in its advantage-seeking efforts, that it cannot achieve an advantageous position just by mostly reacting.

Ludwig and Pemberton (2011) argue that efforts that assure firm survival should be enough. This strives to create a peace of mind and finiteness to "what should we be doing?" and alike questions in that as long as a firm's state is being kept sound no further questions need to be asked or answered to. Even though the argument appears to be rather philosophical, it has an effect on how the study's case is approached.

Taking the survival-argument to be true, the study can be conservative in its approach, focusing on aspects that hinder data utilization instead of going wildly about trying to locate some unknown "opportunities". The questionable aspects within the RBT discussion is not limited to that, however, there are also other issues to it, e.g., with its valuable resource definition. The existence of these flaws point to that direction that to use the RBT literature there has to be a due diligence process.

The core concepts of the RBT:

- At the RBT's so-called boundary is a concept called sustained competitive advantage. A firm's sustained competitive advantage is said to explain why it consistently performs better than a reference group. In the literature, a lot of weight has been put to differentiating between those advantages that can be held and those that cannot, but this kind of an interest only seems to show the theory is aged.

- The theory utilizes a concept called resources that is usually taken to mean, say, the physical assets possessed by a firm. The literature attempts in its own way to put the term in chains, defining it can also be anything intangible such as a process. A better definition might be that resources are whatever concepts that are the best at describing a firm's status, sometimes its success or failure.

- In the RBT's core, there is the argument that some resources act as sources of sustained competitive advantage. That whether a resource contributes is understood to be based on whether it is valuable, rare, inimitable and non-substitutable (VRIN). Also, it is often underlined that all resources are heterogeneous. But with a bit of pondering it seems they may not fit in the reality as well as proposed.

2.1.2 A guide to using the RBT and several practical concepts

All the initial criticism aside, the RBT still represents a tectonic shift away from looking at external factors (e.g. Porter's (1979) five forces) towards looking at what happens in firms internally. This was not a totally novel approach, as there are traces of the RBT to the 1950s and earlier (Penrose, 1959), but the new formulation was something not available before.

What happened next was a massive influx of papers published on the RBT, papers extending it, it diffusing to other fields of study, and papers questioning its validity. These points can be taken to suggest that the real input of the RBT to this study might not be its theoretical firmness but rather its vast knowledge base. That there exists a concept within the theory for any possible need should create a good accuracy between it and the findings in practice. In other words, the RBT should not only offer a method to identify some resources but to also see patterns within them.

However, the sheer mass of the literature means finding a common thread within it is required. As being able to identify different kinds of resources is essential to the study, this shall be the lense through which the RBT literature is looked at. Acedo et al. (2006) offers this specific lense, finding in their bibliometric study that there are three main trends in the research, belonging under the collective term of the RBT[2]. The trends are said to concern classic matters, knowledge, and firm relationships. Additionally, as the RBT will not be the only theoretical body used in the study, it should also be beneficial to connect it to the other theories involved by means other than just declaring the RBT is the sublevel tool. The notions helpful in said connecting, residing in the RBT's more popular theoretical papers, should also prove useful elsewhere.

The other theoretical bodies, value networks and opportunities, utilize terms reconfiguring, synchronizing, and resource nodes which appear in the following

2 Acedo et al. (2006) prefers this term instead of, e.g., resource-based view (RBV). For the usage of term RBT speaks the fact that Barney et al. (2011) have come to use it, too.

descriptions of certain RBT research directions. The motive behind having a display of the popular RBT theory was also to create something that represents a whole before moving on to discuss only those aspects that are absolutely required in the study.

Integration of neoclassical economics

Integration of neoclassical economics has been one natural direction for researchers to extend the RBT. Most notably, Peteraf (1993) looks at the RBT in terms of supply, demand, and marginal cost. She is interested in being able to assess a future resource's potential and knowing the rules determining their profitable formation from a theoretical viewpoint.

Peteraf's most oftenly mentioned contribution is her introduction of terms ex ante and ex post limits to competition, which say that there must exist forces to inhibit, e.g., imitation attempts from competitors before and after the formation of a resource. Otherwise, there should be no sense to attempt new resource creation because its cost should equal its value nor would there be any sustained advantage from possession.

To go on a bit further, the reason why these rather innocent looking terms are often citated is that, not only have they proved their usefulness in practice, they are an antecedent to more detailed theoretical handling. An example of that is Makadok's (2001) fancy normative findings such as that resource acquiral research of a firm should be focused on resources of which estimated potentials are close to those of a competitor's, derived from a mathematical analysis. A finding such as that should be surprisingly useful in practice.

Connecting the RBT to other fields of management study

Connecting the RBT to other existing theoretical structures has been another natural direction for theory extension. In this respect, Amit and Schoemaker (1993) contribute to finding out how the RBT stands on two fronts. First, heavily using term capabilities referring to how resources are used or deployed, they bring organizational and behavioral considerations into a picture that might have been assumed to be of the neoclassical "everyone is totally aware of everything" variety.

Second, a considerable amount of effort is used to condense the being of a firm into a bundle of resources and capabilities which can then be put against those of competing firms on industry level. This strives to connect the internal view the RBT offers to external views of a firm, i.e., the five forces one designed by Porter. But the attempt at creating rigidity is certainly appreciated also by those who would want to see how the RBT stands in relation to more modern theories such as value networks. RBT borne ideas should indeed be quite useful in choosing the optimal ways to look at varying detail dynamics.

Generalising the RBT

Over the years since the RBT's inception and the release of the earlier articles, some refinement of ideas has been inevitable. In Amit and Schoemaker's (1993) footsteps, Sirmon et al. (2007) calls for a synchronization of a firm's set of resources and capabilities to their fullest effect. On the other hand, Lockett et al. (2009) in their review of the RBT stress the limited knowledge and bounded rationality of people, the indeterministic nature of business environments in general.

According to my limited knowledge and search, a less-citated, bold claim by Mathews (2010) offers a perspective that goes further than those of his more often citated peers. Mathews suggests that firm profits as per the RBT can be seen as a special imperfect equilibrium case, making the current theory incomplete. Basically, Mathews constructs a very theoretical explanation for that synchronizing or reconfiguring resources is of importance.

2.2 Identifying resources

2.2.1 Classic resource-based view

Identification of resources is one of the main contributions of the RBT to this study. As it is, various differing aspects of a firm can potentially be called as resources but what actually are should have a great impact on the value of the related analysis. To elaborate on identifying the right resources in the right circumstances, consider a firm that sells a complex product and runs a service business related to it. For the example's sake, the firm could be the Finnish elevator-manufacturer Kone that runs a world-wide around-the-clock maintenance service business related to its products (Kone, 2016). In this case[3], what should be the resources with which the service business scenario is encompassed?

An iterative approach can be used in answering the question and seeing its many facets. In that spirit, listing several aspects of the business that could be called resources and categorizing them as suggested by Wernerfelt (1989) resembles a very basic attempt at trying to understand what is going on in the operation. A basic resource list in the aforementioned scenario could include some physical assets, such as facilities and information systems (IS), people with their embedded knowledge of the business and their duties, and some comparable to physical assets intangibles, such as the access to technical details of Kone products and the business operating under its trademark.

If following Wernerfelt's (1989) advice the identified resources could further be categorized by their criticality to the success of the business to assess the amounts of value that can be extracted from each of them. This would be in line with utilizing

3 The author has limited knowledge of how the business is run in reality. A name of a concrete company was simply used to aid making the case, for illustration purposes. In fact, it is possible to switch the name of the firm without a loss of content.

Barney's (1991) criteria to locate the sources for sustained competitive advantage. The result of the practice could be that physical assets, even though some part of them may be interesting, offer a fixed income over a period of time and are not mission critical in the sense the unique intangibles of Kone trademark affiliation and the insider access to product details are.

People and their specific knowledge and skills may offer some extra value but considering the fact that operations span the globe these must be easily replicable and, thus, should offer a limited advantage (e.g. Zander and Kogut, 1995). An analysis such as this leads to a conclusion that trademark exploitation is what the business is about.

2.2.2 Knowledge-based view

That resource identification and classification outcome may sound well and fine but it may disregard to too large an extent that how everyday business is conducted. An analysis into a firm's operation must go deeper and perhaps only through alternative considerations and views a better understanding of the business can be attained. One such consideration could be that, after all, an international service business cannot be a very simple thing.

It comprises keeping track of thousands of installations, managing a network of suppliers of the actual maintenance work, optimizing pre-emptive care with data analytics, transferring knowledge efficiently within the organization, and so on. In literature, to relate to and to define a space such as this very many similar meaning keywords have been used, e.g., capabilities (e.g. Amit and Schoemaker (1993)), knowledge (e.g. Kogut and Zander, 1992; Grant, 1996), routines (e.g. Teece et al., 1997; Eisenhardt and Martin, 2000; Mathews, 2010), and business processes (e.g. Ray et al., 2004).

At face value, the multitude of the list above highlights an issue relating to no consensus existing on a preferred terminology, but that may actually be a symptom of a deeper problem. It seems that there is no consensus among researchers on the definitions of the terms not to mention how the distinct aspects the terms refer to play out together. For example, Ray et al. (2004) state that resources and capabilities are translated into activities and routines, exposing them to market processes that ultimately assign a value to the resources in question. This is the classical view where aspects of a firm are very much static.

On the other side of the fence are Eisenhardt and Martin (2000) who argue that classical resources bear no meaning, that knowledge-born capabilities that adjust the less important resources are all that matter. Twisting the knife, they add that things such as routines are simple prelearnt reaction models to sudden events. According to them, the kind of resources Ray et al. speak of can be created almost at will without a cost if allowed by possessing some higher-order resource type.

An implication to practice of such an obscure terminology and theorisation might be that utilizing knowledge related resource definitions should be challenging when even the researchers do not seem to find a common ground for them in theory. Then, again, Eisenhardt and Martin (2000) and the knowledge-based view literature in general have a tendency to position themselves behind the idea that in long term only thinking models of people matter and that the long term is the only worthy consideration, which almost assigns the literature in a different league than what is relevant to this study. They are looking for some philosophical explanation when this study wants to keep its feet firmly on the ground.

However, it should be mentioned that more practical writings on the matter do exist. For example, Grant (1996) describes in very simple terms what activities' knowledge needs and dissemination requirements must mean for the boundaries of a given firm and sub-firm organizational structures. This is still far away from depicting definitely why some knowledge-based aspects should explain the business in question the best. It might be so that in practical situations heavily knowledge related resource definitions devolve back into very concrete, physical, tangible aspects.

2.2.3 Relational view

While the knowledge-based take on resources very much resembles a black hole, sucking everything into it all the while performing deformation, it does not necessarily offer a comprehensive model for firm dynamics because of its tendency to overgeneralize. It does not exactly stress that what could potentially be an interesting perspective, that how various resources, activities, and bundles of them function together, in relation to each other. Dyer and Singh (1998) use term relational view in their so titled paper to refer to some firms having superior performance due to their resources functioning so well together or in connection to resources of other firms.

They use an example of a Nissan plant to which a conveyor belt was built from a neighboring supplier facility to enhance product flow. In our service business scenario, some relationship borne advantages are as easy to spot, e.g., there is a possibility of integrating some of the main company's information systems to those of the service business to create something that the competition would lack (Piccoli and Ives, 2005). There is also that the data feeds would go both ways, creating an incentive for the main company portion to develop and maintain the integration.

On the other hand, some resource relationships may be more subtle, for example, IS and personnel knowledge were both mentioned before but not much weight was put into how these are complements to each other. Zander and Kogut (1995) speak of individual knowledge embedded on some wider structures of a firm, such as culture, organization principles, and the general knowledge base in a given field. IS, in the sense of physical computer implementations, can be understood acting in a similar manner to firm structures because personnel activity is linked to, or even defined by, however they have been designed. Aral and Weill (2007) offers evidence of this, finding the extent of IS resources tied together with activities is correlated with firm performance when the amount of IS resources in use solely is not.

The relational view also offers an avenue to understand how potential new business opportunities are found and exploited. The term used by Sirmon et al. (2007) and many other authors is resource recombinations, or reconfigurations, referring to how existing resources can be recombined to serve new purposes or old in a more efficient way. Sirmon et al. do a lot of groundwork in their study, among others, they divide the possible recombination efforts into stabilizing, enriching, and pioneering ones.

Sirmon et al.'s terminology refers to the magnitude of change in a resource configuration. Additionally, the terminology refers to the manner in which the recombination effort is done. Stabilizing concerns simply tactics to achieve limited advantages. Enriching is about bringing new things into old setups. Pioneering may be the most interesting of the terms that, in Lockett et al.'s (2009) perception, involves creativity, learning, and creation of new resources, perhaps diversifying a firm's offerings. The service business could, for example, migrate towards offering total facility asset management solutions, acting as a kind of a hub.

Considering the insights from all the three views, are they able to provide a sufficiently good understanding of what might be going on within the service business? Do they take a note on all of the important details? Most importantly, can they serve as a basis to spot, detect, and estimate the amount of future business opportunities? To answer the questions, at the very least, it should help to find out how successful the past RBT research has been, whether they have failed, where, and how.

2.2.4 How is the RBT's track record?

Possibly the most comprehensive study to date on the RBT's track record is that of Newbert's (2007) look into it applying empirical papers. The papers he studies typically attempt to link some variables representing the resources to some other variables representing the sustained competitive advantage. Newbert finds that 53% of 549 individual tests in 55 articles support the RBT, i.e., a link appears to exist. That percentage, assuming the articles examined to have been rigorous in their approaches, would be quite miraculous.

However, with a closer look the results of the individual experiments show cracks. Tests utilizing a classic resource, 42% of the total number of tests, support the RBT only in 37% of cases. That means the approaches used in the rest of the tests have to have contributed in a disproportional manner to bring the total support found to above half. To wit, it seems the more exotic the approach, e.g., assessing the effect of firm knowledge on firm performance enhanced by entrepreneurial orientation (Wiklund and Shepherd, 2003), the more certain is the outcome. That kind of a study and its findings do not appear to be very honest, putting a shadow onto the RBT.

That how the academic community received Newbert's findings is characterized by the fact that the RBT support percentage is of average in the field (Newbert, 2007, p.136). Armstrong and Shimizu (2007) describe clarification and refinement of various characteristics, such as terminology and boundaries, are required to pass through a phase of internal struggles. In general, there seems to be a tendency to hold the sayings of 1990s as canon, for example, not daring to combine rareness into inimitability as Armstrong and Shimizu explain, and not even thinking about going further and reformulating the criteria altogether.

Some of the most negative notes come from Hoopes et al. (2003), calling the theory tautological and making it sound a liability, a drag. However, Hoopes et al.'s saying that the RBT tends to be non-disconfirmable does echo with the more original papers described. In the RBT's support, it has to be said that often a concept such as a whole firm's performance consists of too many things, averaging exceptions, to give an indication of a superior, yet small in scale, resource in use (Ray et al., 2004). Even though a concept simple to grasp and to be aware of, the flaw is apparent in some cases of weak findings. The instant track record of the RBT argues for using also other theories besides it, possibly something more tailored to analyze whole industry structures, something stressing that how single resource nodes form networks.

2.3 Analysing an industry: Value networks

2.3.1 Origins of the value networks concept

Bringing up the importance of seeing resource nodes being a part of something bigger is a precursor to the value networks concept, a kind of an extended and refined version of the relational view. Only this time the emphasis will not be on digging as deep as desirable into dynamics of one case but, instead, on understanding what kind of insights are brought up by considering firms in constellations (Normann and Ramirez, 1998).

In essence, broadening of perspective happens this time to the opposite direction, to outside and beyond of a single firm and its relatives, to contain more of the numerous individual flows and forces, acting to supply some final end customers. Ultimately, the concept of value networks offers a pathway to comprehend business opportunities.

Initially, there was the term supply chains, then at some point it was determined value chains offers a better description, and last, the word chains was replaced with networks in another step of the evolutionary process (Herrala et al., 2011). Of course, the reality is never that straightforward, and also in this case the terms had existed and been utilized much before their current uses (e.g. Stabell and Fjeldstad, 1998). However, the important thing here may not be the terminology used but that what was understood by them because that definitely came later.

Replacing the term supply with value coincided with firms offering services, not really any physical goods, in an increasing manner, thus inspiring researchers to refocus (Lusch et al., 2010). Exchanging the word chains to networks was also a result of such a change. With different activities spread out more thinly across a greater number of firms (e.g. Lusch et al., 2010; Peppard and Rylander, 2006), and them happening in parallel (Herrala et al., 2011), a value chain as a term was not fit to contain these new realities.

An example of this change is what has happened in the internet advertisement space (Raeste, 2017) illustrated in Figure 1. It should be mentioned the source is a newspaper article, and thus, is used only for the quickest of notions. Simply consider how the advertising setting has turned more complex, network-like with the mediator party and the IS-centered nature of the operation when compared to traditional marketing schemes. The actors are also connected in a greater number of ways than before in this new constellation.

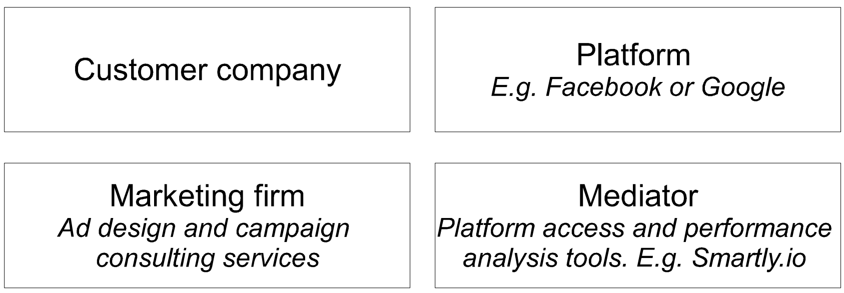

Figure 1. Actors in internet ad space. Each of them can have multiple connections to the other actors. The picture should be understood as illustrating a point, not as a lay of the land, because it is based on a newspaper article. (Raeste, 2017)

2.3.2 Approaches to spot common themes within value networks

As an attachment to the value networks concept, a favorite thing among researchers has been to offer various frameworks to analyse them. The usual frameworks are quite similar in their approaches but there are surprising differences between expected outcomes. For example, Herrala et al. (2011) offer a basic framework with questions relating to activities, resources, relationships, influences, resource limitations, and the end customer's perception of value.

Peppard and Rylander (2006) consider value networks in quite similar if not a bit more abstract terms, but ultimately answering questions of *cui bono* and key interests[4] of one's own firm. There is a clear chasm between the two approaches as

4 Peppard and Rylander's (2006) term used in their article is "business logic". They are interested in things such as where is a firm's best place to play, where a firm's strengths can be leveraged the

Herrala et al. consider a value network to be a cooperative activity while Peppard and Rylander not so much. It seems Peppard and Rylander adopted and transferred some of the hostile, broken feelings of their case's mobile telecom operators into their paper. Applying the two frameworks should actually lead to quite different suggestions for firms in practice.

As a third framework example, Al-Debei et al. (2013) have been pushing their technical take on value networks. Their framework offers some additional in-depth considerations that are missing in the first two. For example, they mention that a value network can be open or closed, affecting, e.g., the speed, quality, and the amount of research and development (R&D) activity within it. An example of a successful closed network is said to be Apple's products accompanied by the store ecosystem (Al-Debei et al., 2013).

Having an open network, however, is seen preferable because it opens the door to all kinds of new opportunities even though one's control over it is reduced. An open network is desirable because for one thing it may nowadays be difficult for one firm to possess all the knowledge required to create interesting offerings to end customers (Lusch et al., 2010). Another reason may be that having an open network makes it by default to encompass a larger area.

Another interesting matter is that of governance (Al-Debei et al., 2013). Paying attention to who controls what parts of a network is a thought similar to that of Peppard and Rylander's conclusions but in a better format. Because looking at other firms and their realities should be more telling than looking only at one's own. Said in other words, sometimes looking at others is required to be aware of one's own opportunities. Al-Debei et al. (2013, p.353) explains that with an active behavior UK mobile telecoms were able to change existing regulations and norms in the whole industry. These statements may have been a bit too indulging but, still, there is an important lesson of not getting locked in only looking at yourself.

2.4 A continuum of value networks: Opportunities

2.4.1 Reconfiguring a value network and the opportunities within

Discussing value networks brought up a lot in the form of themes but its main contribution to this study is, in fact, creating a theoretical understanding on business opportunities, on what they are. Previously, opportunities were briefly mentioned as if springing off as a side product from a resource-based analysis of a firm. In the relational view discussion, opportunities were spoken of as possible resource recombinations. The value networks stamped literature sees opportunities very much in the same light but it simply offers more than the RBT papers.

Lusch et al. (2010) define a concept called density to analyse value networks, which

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most, and on the other hand where competitors are in an advantage.

they consider to be "living organisms, learning, evolving, and adapting"[5] all the time. They explain a maximum density is reached when various resources in a network are in their best possible uses. This introduces a nice bit of theoretical formalism to opportunities when handling a resource-based framework.

Furthermore, Lusch et al. have quite many practical ideas about where to look for those said opportunities. They explain reconfiguring form to improve density is one way, which brings to mind all things IKEA, e.g., do-it-yourself furniture. They have, however, a bit more advanced example of reconfiguring in mind. There has been a trend of putting goods in oversized boxes in the retail sector, as that increases sales, so now Wal-Mart has questioned the sense in this and offers incentives for using smaller packages.

That kind of a change is deemed to require a confrontation of old, held ideas, not to simply do things better without any drawbacks or blowbacks as might be the case in the IKEA example[6]. Hence, a reconfiguration attempt can certainly involve also other dimensions besides form, namely, place, possession, and time (Lusch et al., 2010). Of those, possession is quite interesting as that is a direct reference to outsourcing, which is a very prevalent practice in the modern business world. To mention one more, process re-engineering has been another trendy thing to do since the 1990s.

Possibly the most central point Lusch et al. (2010) make is that a value network should seek to liquefy its information resources. Using an example of an auto manufacturing network, they argue for creating and integrating infomediaries, network nodes analysing and transferring information inbetween other nodes. For example, it is said an infomediary can figure out customer preferences based on information related to car sales and warranties, and with that, aid bringing distinct value network parties together to design better future offerings.

What was just described is not said to be easy, quite on contrary, the usual practices of standardization and reducing complexity take one only so far. Moreover, Lusch et al. (2010) come up with a never-ending list for future research directions on this topic and the topics in the rest of their study. To contain that list somehow, let's just say they would like to know more about an end customer's optimal role in a network especially in relation to innovation efforts.

2.4.2 Opportunities on a network's boundary and beyond

Lusch et al. (2010) concerned themselves mostly with opportunities within existing value networks. They wanted to know how existing resources could be more efficiently arranged within known boundaries of predetermined value network constellations. They did suggest creating new resources, but those were to function within the existing boundaries.

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5 Lusch et al. (2010, p.23).

6 Letting people construct their own purchased furniture may even be revenue-positive.

Theoretically, their view could be said to represent only one half of a whole. The other half would consist of the uses of resources that are outside their normal value networks, perhaps in different ones, or in ones that do not yet exist. At this point, it should be stressed that this statement is a very abstract, theoretical construct, and whether it serves any practical purpose is unknown. However, the essence of it could be described with Sirmon et al.'s (2007) category of pioneering maneuvers while Lusch et al. (2010) were interested in stabilizing and enriching.

Following that warning, I would have liked to have found a more thorough take on the matter in the literature but, alas, there is only some that even speak of it with a relatively comparable terminology. Of those, Spring and Araujo (2013) get very close, studying services innovation in a traditional manufacturing supply network. Something interesting in their study is that they put a heavy emphasis on Penrose's (1959) contributions, neglecting any insights the RBT literature that has come after might have had to offer. They say it is not interesting to define some new typology of resources for a services-centered business and, instead, they are fine playing with the existing definitions. They simply look at how they are used to generate new offerings, i.e., used in new purposes in new ways.

What is the most interesting, of all the RBT's utilizable contributions, Spring and Araujo (2013) specifically mention that dynamic capabilities (Teece et al., 1997; Eisenhardt and Martin, 2000) do not fit well into their study. They explain dynamic capabilities could represent some systems for new product introduction but that would not be the point, the point is for them to understand how new services with a potential to change a firm's business model come to be in the first place. Studying what is done and how to exploit a found opportunity to its maximum potential is besides the point. Specifically for the purpose of denoting all the potential uses of a single resource they coin term "Penrose-services".

Spring and Araujo's (2013) empirical findings may be equally fascinating as their theoretical positioning. They describe there were multiple instances of "triggers", originating from the case firm's existing value network that set the firm, manufacturing, e.g., gas turbine parts, to think on responses. For example, one such trigger was a customer demand for a new kind of a component for which there was no current know-how inside the firm on how to do. That led to an expertise improving chain reaction beyond the boundaries of the firm and its currently used practices.

Overall, the triggers are described to have led to new responses, new ways of doing business and, eventually, to marketing these new capabilities. The triggers might have as well originated from outside the firm's existing value network. If that was the case, then, that would have essentially amounted to an instance of exploiting an external opportunity. To condense all of this, these opportunity revealing triggers could be understood as some important aspects that when visible depend on a given firm's resource configuration to take advantage of.

2.5 Specific study-related resource concepts

2.5.1 Should looking at information systems assets be sufficient?

Because information systems (IS) will play a major role in the study it should be essential to look at this topic separately. One relevant question is what resource concepts have been used to describe operations involving a host of IS in the past. It turns out an optimal concept selection might actually depend on the length of the time window one is looking at. Ultimately, this creates an argument for the study to focus on the status of firm IS assets, when other things considered is reasonable, rather than some other more innate properties.

Within this study, the sole term IS is used to refer to computer software implementations, leaving out the role of people which could otherwise be understood to be part of the package. Interestingly, IS related academic study has had some tradition to utilize the RBT as a theoretical basis as explained by, for example, Son et al. (2014, p.654) in a recent article (for more examples, see Bharadwaj (2000) and Arall and Weill (2007)), making it all the more fertile-looking ground for exploring.

But to proceed with the original purpose, Wade and Hulland (2004) collect IS and it related resource concepts across a horde of studies completed in the field with an intent to apply a theoretical RBT framework onto the collection. They take resource concepts from about twenty studies and arrange them into eight categories. For example, three resource categories are named as IS infrastructure, IS development, and cost effective IS operations. These are said in their respective order to relate to physical software solutions in use, employees' awareness of the latest technological trends, and the capability of a firm to stay out of trouble within the IS scope to avoid, e.g., cost overruns with projects.

Resource categories such as those can easily be understood to relate to computers, but then Wade and Hulland make a case for some a bit more unorthodox categories. Namely, management of external relationships, IS-related business partnerships, and market responsiveness also known as dissemination of information are identified as further categories. These categories, already discussed to some length within value networks, are seen to heavily depend on people's routines and processes a firm has in place. The categorization could be taken to indicate that a comprehensive IS case study would not only have to concern itself with physical IS assets but also with the practices of people.

This implication for practice is taken even further by Wade and Hulland's additional deductions. They use a framework that combines the common RBT, Peteraf's (1993) ex ante and ex post definitions as well as Barney's (1991) VRIN attributes, to evaluate the eight identified categories. It should come as no surprise that they find the latter resource categories as being even more important because they are not of supportive nature to a firm's operations. That they should be prioritized over looking at computer solution specifics. This is very much in line with the usual thinking that the former three categories are complementary (Rivard et al., 2006).

Even though the latter categories and the depiction of their impact seems to clearly overshadow the former, I would beg to differ. For one, Piccoli and Ives (2005) offer a crude attempt to attribute the successes to the former resource category. For another, there is evidence for that IS assets have to be used alongside the activities of people to notice an effect on firm performance (Arall and Weill, 2007). Arall and Weill find that improving either the IS assets or the activities of people have a tendency to mutually reinforce the other.

With some elaborate reasoning an argument could be made that the former categories, the IS infrastructure related resource concepts, can belong to the core of comprehending a firm's operations, especially, the shorter the timespan one is looking at. Consider, for example, Amit and Zott's (2001) findings of four e-business success factors of novelty, efficiency, lock-in, and complementaries, should not these be initially traceable to some properties of IS assets, and only after that to the ideas on which they were built upon?

If the purpose is to find rapid, sure ways to improve a firm's situation, looking to change some held ideas or underlying ideologies of people would probably take too long. This could very well be the case with, for example, market responsiveness, that the default target of improvement endeavours should rather be the IS assets, as long as they can be seen to bear a relevancy. Vice versa, if given an infinite amount of time, it might pay off to even go to the metaphorical derivatives of people activities, dynamic capabilities, Teece et al. (1997) talk about.

2.5.2 Concepts to explain firm decision making and to estimate opportunities

The IS discussion attempted to steer resource concept selection in a certain direction for some cases, arguing for a practical approach to check the status of in-use IS assets. When thinking of what other such advice the study could benefit of, a general expectation for how decisions are typically made in firms, if such advice is even possible to attain, is one, and a way to estimate the number of opportunities is another that are relevant. Ultimately, it appears that considering firm decision making brings about an estimation method for opportunities. That the extent of opportunities can be estimated by assessing the extent of aspects barring them, and that this is possibly the most one can wish for.

According to Collis (1991), firm decision making is not much of a matter of neutral calculation but of prevalent, difficult to alter thinking models. He illustrates that what might be called path dependency in his bearings industry case study where he utilizes a concept called core competencies, a resource of sort. He looks at three firms within the industry and their efforts over a period of time. According to his description, the first of the firms appears to overfocus on expertise, though, reaching a somewhat commendable pinnacle of a clean room factory in Thailand. The second is said to have had a weak position from the start, leading to submitting to a flawed custom orders strategy. The third, wanting to be a first mover most of all, appears to have been able to navigate the perils the most effectively, perhaps because this core competency allowed for the most flexibility. The stagnant core competencies listed appear to explain the firms' actions and end positions within the industry in quite a prophecial manner. The takeaway advice is that at any point of time when firm directions were considered a serious effort would have been required to alter the default responses. Changing the rules of the game, so to speak, would have been unworldly.

To make a contrast, Tripsas (1997) has studied the typesetter industry, including an unusually long timeframe from year 1886 to 1990 with four generations of typesetting machines. She looks at people's skill configurations, a classic resource concept, finding that between generations they change by 50% to 90%. The maximum happened when the mechanical machine was exchanged for an analog phototypesetter. For some value, she finds complementary assets act as a shield between generations, that when they retain value to the next generation the incumbents have a strong position and vice versa.

The point is Collis' core competencies stayed much the same, showing value to predict firm futures, while Tripsas' employee skills changed radically over time with much less predictive value. But, still, even the Collis' resource concept appears to only predict what courses of action will be chosen by the firms in question after being aware of facts. Consider an example of another but yet similar matter, that, e.g., reconfiguring business processes has been a hot topic for the last two decades (Lusch et al., 2010, p.24). Is it any wonder that in academic studies we read that it is those business processes that are important? We look at some case and deduce it is those resource concepts that work wonderfully here. Then, the situation changes and we find new fresh resource concepts that explain the changed situation so well. But nowhere was there a sign in the old setting, pointing to what would be valuable in the time to come.[7]

It seems the best one can do is to remove visible hindrances, barriers, and to create flexibility as per Collis (1991) to be ready for the future. If the advice is taken to heart, charting opportunities by mapping existing limitations appears almost as the only viable method for estimation. It is based on the argument that nothing more definite about future and opportunities themselves can be said before they are already too apparent.

7 There is that one other study that plays a similar story, talking about how it is deemed a plate is missing carrots and then carrots are added, illustrating some other or the same deficiency. But the title and author(s) elude my memory.

2.6 Previous literature on data utilization in an energy industry context

To round up the literature review, it is still a necessity to describe the existing topic specific literature. Even though there exists a mass of literature on the aspects of an energy industry, especially if doing a global search, literature also concerning data utilization is much more limited. Adding one more search parameter, that the research had to be performed concerning Finnish details, would be in vain as there are only so many research reports on the Finnish energy industry in the first place.

Table 1 lists several energy research samples with a bias towards those that are data utilization relevant. The Finnish samples represent more of the whole research collection available while the few samples from the world were hand-picked to portray what kind of interest there has been around the world specifically in regard to electricity consumption data utilization.

Interestingly, it appears that the Finnish research outcomes have been recycled in the various reports and slide shows available on the subject, having had surprisingly limited refinement inbetween. In these reports, the tune and the level of detail is strongly on the general side. This is exemplified by that even the best of the Finnish data utilization notes (Energiateollisuus, 2013a, p.12) depicts rather crudely the whereabouts of opportunities, not giving any concrete hint about what they could be exactly. A reasonable question would be that whether the lack of development with those opportunities is due to some difficulties in proceeding or that the said opportunities do not actually exist. Whichever the answer may be, it is the Finnish articles that want to figure out the role of data within energy industry aspects the most.

On contrary to the Finnish research, samples from elsewhere are more concrete but they are also more limited to certain specific topics. To name a couple of topics, electricity price forecasting and various energy efficiency related aspects have had global attention but, still, there is not much writings about things such as big data and business intelligence within, say, power grids. Electricity demand response, meaning altering consumption in a reflection to electricity price changes, has gathered some detailed work but that seems to be the limit of global data-focused articles for the industry. It appears that energy industry data utilization is as close to an uncharted territory as is possible in the modern world.

Theme	Sample findings	Sample source
Finnish samples		
Future vision	Energy in year 2025 vision, including an interesting hot zones analysis for new services	Energiateollisuus (2013a)
	Year 2030-2050 vision, listing trends	TEKES (2017)
Demand response	Descriptions of various pilot demand response projects	Fingrid Oyj (2017)
	The most comprehensive demand response report to date.	Järventausta et al. (2015)
Consumption data utilization	Aspects domestic customers would like to know about their consumption data	Energiateollisuus (2015)
IS infrastructure	A report of common IS needs within the energy industry preceding the Datahub project	Energiateollisuus (2013b)
Samples from the world		
Consumption forecasting	Regional power consumption data to forecast future demand (within the region)	Taylor et al. (2006)
Consumer characteristics	Consumer characteristics to optimize power tariffs	Gajowniczek and Ząbkowski (2015)
Data to manage a microgrid	Data utilization to have a role within a microgrid management	Erdinc and Uzunoglu (2011)

Table 1. A few samples of energy research reports. The Finnish samples represent more the whole collection available while the samples from the world are hand-picked for the study's data utilization topic.

2.7 Synthesis

Figure 2 depicts the study's theoretical framework and that how it answers to the research questions. Resource-based theory accompanied with value networks basics is used to make sense of the energy industry and its actors. It was deemed important to have a solid foundation, thus many possible angles were elaborated for comprehending industry actor operations. An argument for reducing complexity was also represented, that simply looking at IS asset specifics could be sufficient in some cases. The idea behind the argument was that IS assets in particular should be able to bear purpose in a similar manner to more complex resource concept definitions. This is partially what will be done with distribution system operators (DSO).

Following industry and actor illustrations, value networks literature accompanied with the opportunities discussion will be used to define interesting actor-specific themes that underlie their opportunities. These themes, though extracted from the literature, will be related to the resource concepts that were used to comprehend each of the actors' operations within the industry. For example, liquefying information resources was one of Lusch et al.'s (2010) main contributions, and it will be central to the IS-based DSOs' future directions. Some themes may not, however, be as easily distinguishable, for example, a lot of the findings concern actors' optimal roles as discussed by Al-Debei et al. (2013) and Peppard and Rylander (2006). Perhaps the most fancy themes findings originate from the likes of Collis (1991) who's findings point towards changing prevalent mindsets.

Finally, the last research question ponders about the outlook for data utilization opportunities. Previously identified themes and the opportunities they are typically accompanied with will be helpful in this respect, but they do not offer quite a comprehensive answer one is looking for. There is also that nasty aspect to opportunities that they are quite invisible. The literature and a few elaborations helped to determine that possibly the best one can do to estimate the extent of opportunities is to assess the extent of their existing limitations. To push the analysis further, however, the literature offers a nice toolkit to analyse that who might want to tackle the obstacles and start developing promising industry regions.

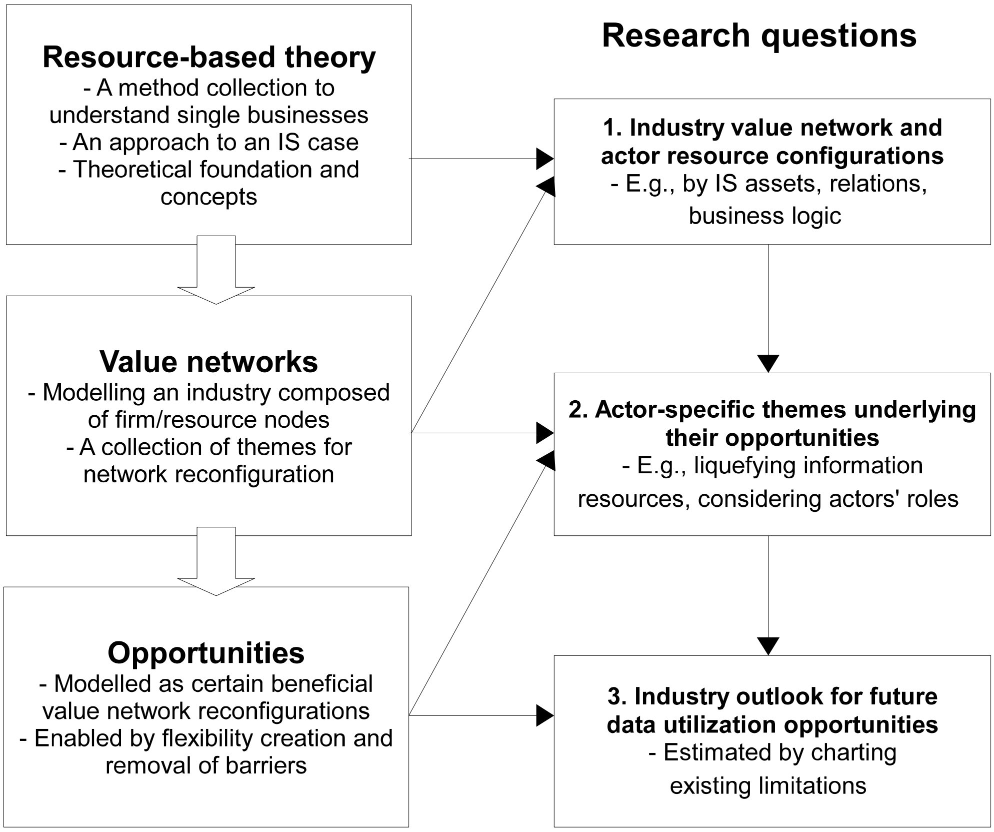

Figure 2. How the study's theoretical framework answers to the research questions.

3. Method

3.1 Grounded theory approach extended with foresight process particularities

In methodological terms, the manner of research conduct of this research shall follow a grounded theory path with a little bit of extra flavor. Charmaz (2014) describes that the grounded theory is a bottom-up approach, basically, reconstructing a theory through data collection and analysis, utilizing a few common techniques. Perhaps the term grounded theory is better understood by acknowledging that the motivation for its creation has been to legitimize the place of inorderly real life research in offering scientifically valid results (Charmaz, 2014).

Looking at this study, the initial position here differs slightly from a pure grounded theory approach. It was explicated that the desired outcome would be a view on the energy sector value network from a data utilization perspective, which already contains a certain emphasis on the theoretical basis involved. On that kind of a premise, Charmaz (2014) explains an independent analysis should precede the literature review. However, the initial theory utilized in the study can be described to have been a ballpark estimate of where the eventual theory constructed was to land. How one was looking at the data and the way to put it together, that evolved a lot during the data gathering process as it should have in a grounded theory research project.

There is also that one other peculiarity to this study, namely, that it has to heavily attempt to peek into the future. This gives the study its special flavor, there has to be an application of a certain foresight process. Figure 3 depicts a very simple version of a general foresight process flow (cf. Popper, 2008, p.67). One notable thing in the picture are the multiple questions relating to understanding how the object of the study functions. It almost states that predicting future is a trivial matter after the current state of affairs is really known.

Popper (2008) has studied foresight methods and especially their selection in research endeavours. A half of the about 900 cases he included in the 2008 study used literature reviews, expert panels, and scenarios as their foresight methods of choice. Brainstorming, surveys, Delphi, and interviews were used in about 150 cases each while a neglective amount utilized specialized techniques such as backcasting[8] or patent analysis[9]. Of those mentioned, the Delphi method is particularly interesting as its idea is to refine anonymous expert assessments through multiple judgment rounds. The attached anonymity removes many of the typical hindrances in finding correct solutions in groups and this may be even more true for cases of conflicting

8 Backcasting means visioning a future state for a system and then working backwards to find out what is needed for that to become a reality.

9 As the name implies, patent analysis searches for clues from the patent registry but there is an associated delay of approximately two years to this in Western countries. (Georghiou et al., 2008)

interests.

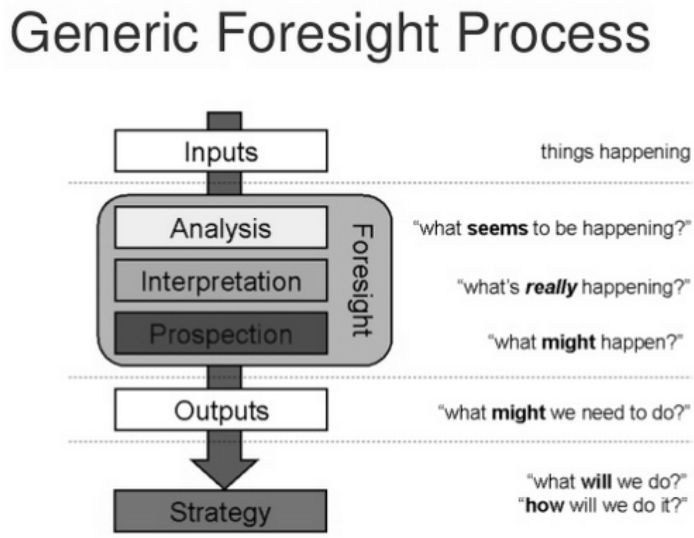

Figure 3. A foresight process as illustrated by Conway (2013). License: CC BY 4.0. https://creativecommons.org/licenses/by/4.0/.

In general, Popper (2008) finds a typical foresight exercise applies five to six distinct methods and that preferred methods vary quite a bit geographically and per research and development (R&D) intensity of the target country. He does not spot any outstandingly strong trends but the more creative and interactive methods such as brainstorming do seem to be gravitating towards low R&D intensity places and Asia. On these creativity- and interaction-focused methods, an argument could be posed that they are less about getting to know how things actually stand and more about visioning the future[10]. This links back to the model in Figure 4, suggesting that this study should prioritize methods from pools opposite to those that aim to vision too pure ideals.

3.2 Overview and the premise of the research process

The aim of the study was to be able to assess the extent of loosely data utilization related opportunities within the Finnish energy industry. Additionally and more interestingly, the study targeted to understand what kind of developments their successful exploitation would mean and necessitate. To reach that objective, some milestones were set for the concrete research process. It was determined scanning for details in the vicinity of Datahub, the upcoming central information system, should have a high initial priority. The research process can be said to have propagated from the origin of Datahub, querying various industry actors about their ongoing business

10 Popper (2008, p.72) assigns the methods on an expertise-interaction vs. evidence-creativity map.

activities and thoughts on data utilization and the Datahub itself. This interview-based process constructed a view of the energy sector from the data perspective piece by piece, serving the follow-up analysis. The research process is pictured with more details in Figure 4.

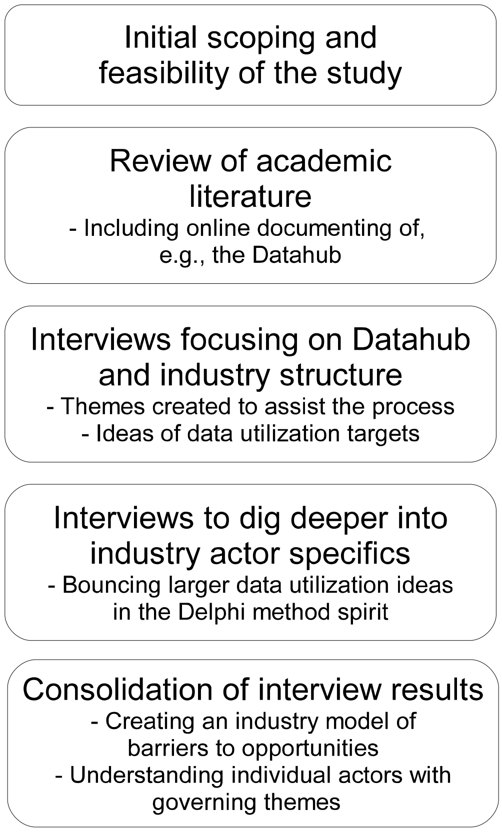

Figure 4. The research process illustrated.

An alternative approach, resembling the first instinct of many, could have been to focus on the properties of data itself. Techniques of value extraction from data, perhaps taking a close look at some pilot targets' existing IS architectures, could definitely have formed a core of an alternate study on the topic. This method would have also offered a quick shortcut out of the energy sector sphere of influence but, if one was to travel there, would they have found a hidden gem or rather a void?

It was decided quite early on the risk of the latter was too big and to focus efforts in such a way would be quite inappropriate. A justification of a sort is also that any uses for the data outside its natural environment should take a longer while to become reality. In general, betting on some big future payouts is not a good strategy and thus such opportunities should be heavily discounted. Simply, they do not offer as much value as one would think.

One thing to note is that there are corresponding, similar efforts as Datahub in a few other countries, and some clues could have been found from, e.g., the Netherlands where the project is already in production. However, for simplification purposes and present language barriers[11] these directions were left out of the study. In the case of the Netherlands, a Dutch transmission company representative had said on data utilization that it had been on the agenda but for the time being there were no concrete new business applications. Being aware of insights such as those helped in steering the study.

Role of online documents and case industry literature

Initially, and during the research process, various documents and webpages were scoured through. In an effort to get to know what various parties think within the energy sector, "Älyverkkovisio" of the Finnish ministry of economic affairs and employment (Työ- ja elinkeinoministeriö, 2016) and "Future of Energy in 2030...2050" by TEKES[12] (2017), to name a couple, were quite helpful in providing some insights into the prevalent mindset within the sector. They also provide some ideas of what the future might look like on a larger scale. For Datahub, Fingrid Oyj offers detailed specifications for the upcoming implementation.

While there is a lot of information available online there is typically an apparent lack of clear articulation of what people within a system exactly think of matters and especially what are the things that keep their minds busy. This might be partially attributable to the detachment of writers of documents from day-to-day operations but might also be that people tend to not practice such clear articulations. Documental anecdotes were at times quite useful at confronting and challenging interviewees to break their otherwise preferred neutral tones, to reveal how things actually stand in their opinion. Of all the available documenting, only those specifying the upcoming Datahub implementation were used directly in the study's findings.

3.3 Interviews

Refinement of interview questions

Expert interviews held in the semi-structured format constitute the main data input for the study. In the beginning, a few pilot interviews of persons knowledgeable of the inner workings of Datahub were conducted with a generic questionnaire schema. This initial schema asked the interviewees to describe things such as different elements of business activities they were associated with in details, knowing of no better. Nonetheless, a couple of them worked really well. In these, the interviewees practically transferred a big chunk of their knowledge to the interviewer in a very fluent process, perhaps because of their large expertise bases on the matter and willingness to share it.

Those first few pilot interviews started a process of constant refinement of questions

11 The projects tend to be documented in corresponding countries' languages that are not English.

12 A public Finnish agency funding innovation.

posed to the interviewees. Certain industry themes specific to the interviewing process, e.g., electricity consumption profiles and energy efficiency, replaced most of the generic industry landscape and business dynamics related questions. On contrary to a quick thought, the latter aspects were not at all ignored with the new format, just asked in a way leading to finer responses. Following that evolution, larger scenarios, or data utilization opportunities born of earlier interviews, were brought in to the schema so that the next interviewees in line could give their assessments on their plausibility. What this achieved was to have a version of the Delphi method in use with those adjustments that there was not exactly a panel of experts present nor were the developments given to the same people. But, nonetheless, feedback was received on various anonymous ideas which were improved over the course of the interviewing process.

Industry coverage and interviewee details

Over the whole process, fourteen people were interviewed in total. Table 2 portrays how the interviewees selected represent the energy industry, i.e., the kind of a coverage the selection creates. The left column of the table depicts a categorization of relevant core actors of the industry and the right column shows in broad terms the main contribution areas for each interviewee. National electricity transmission is a rather uninteresting area as it is state-controlled, explaining the lack of focus on it.

Looking at Table 2, that how the interviewing process propagated and saturated is easily seen in the reverse pyramid shape of the letters. As the process went on, topics that were not wholely within the expertises of people yet interviewed were nonetheless being described in some details, reducing the need for consequent interview sessions. Saturation could have possibly been achieved with less than the number of interviews in Table 2 (Eskola and Suoranta, 1998). National electricity transmission to feed individual distributor grids connected to it is a state-controlled activity, and thus of less interest for the study.

Information about interviewees' positions and their associated organizations are displayed in Table 3. The identities of people interviewed and the names of their organizations were promised to be kept hidden. The interviewees were gathered by them being known contacts, having earlier interviewees recommend them, and also by going through suitable organizations and approaching them on the matter. Two of the interviewees were approached in an industry event. A common characteristic among them all was that they were interested in the study and its potential findings, explaining their willingness to chime in their views.

Electric energy industry core actors with Datahub	Interviewee's expertise
Metering and its information systems	A, B, C, D, E
Information systems solutions for intra-actor processes	B, F, I
Datahub to contain information flows between actors	A, B, F, G
Regional electricity distribution	F, I, J, K
National electricity transmission	-
Electricity generation	F, H
Electricity retail	F, H, I, L
Extra-industrial components, i.e., of the outer boundary	
Energy procurement, energy trading	L
Energy efficiency consulting	M, N
Regulation, lobbying	G

Table 2. Interviewees' expertise per energy industry component.

Interviewee	Position	Organizational focus
A	IS development	IS infrastructure, metering
B	IS development	IS infrastructure, metering
C	Sales representative	Sales, metering
D	Product manager	Services, metering
E	Product manager	Services, metering
F	Customer relationships manager	IS for distributors, retail, etc.
G	Senior adviser	Energy regulation, lobbying
H	Product manager	Electricity retail, generation
I	Grid operations	Electricity distribution, retail
J	Grid development	Electricity distribution
K	Grid operations	Electricity distribution
L	Senior energy broker	Energy trading
M	Consultant	Energy efficiency consulting
N	Consultant	Energy efficiency consulting

Table 3. People interviewed, their positions, and their organizational foci.

Interview session practices

On the specifics of the interviews, the face-to-face, or by phone, sessions lasted on average 40 minutes, though, the longest took one and a half hours. A sample questionnaire is in appendix A. As can be seen, many of the questionnaires had some tailoring to suit each respondent's expertise set. The questions were sent to the interviewees beforehand so that they had time to think on their answers. According to my experience, this is an especially good practice with by phone interviews because it seems that people going to be interviewed by phone are more likely to have read and pondered on the questions before the actual event than those going to be interviewed face-to-face. Also, if not that, they at least have a written reference of that how the interview is going to go. The interview sessions were recorded and overall they followed the semi-structured pattern that allowed me to ask for more details when needed.

During the interview sessions, some pitfalls worthy of mention were encountered and, on the other hand, some that were warned about by a few authors were not so present. Perhaps the single most present pitfall was that the interviewer had to be willing to embarrass himself to get valuable information. Then, even though the general guideline is to not present your own opinions, i.e., the interviewer should not appear as omnipotent to quote Flick et al. (2004), it sometimes may pay off to sharpen the questions a bit. In the beginning, some effort was also used to create a relaxing athmosphere for the interview sessions but this practice seemed to be rather superfluous. Alas, some things are only noticed when they are missing and later during the process there were a couple instances where an initially created relaxing athmosphere could have been beneficial. (Flick et al., 2004)

3.4 Analysis and display of findings

To bring together a study's raw data, grounded theory practitioners talk about reconstructing a theory (Charmaz, 2014). Comparable studies typically represent elaborate and strict designs or plans of how they analysed their inputs. For example, they may explain how they went through interviewee sayings one by one, codifying and categorizing them, and that finally revealing something about the big picture. Even though interviewee sayings were gone through in a similar manner in this study, as text, speaking of a strict process would be cheating.

It took a long time to even figure out the desired angle from which to look at people's sayings. The fact that I did not immediately see how people's answers were contributing to the study's topic was one reason. In retrospect, interview questions have also a bit to do with that but, then again, the best questions are asked only after knowing the answers. It appears that studies that desire to be more than pure reports have to go through a process like this (Eskola and Suoranta, 1998).

Perhaps more interesting than the method of analysis is that how I decided to arrange the findings. More specifically, that what was achieved with their per actor arrangement, and then concluding with industry remarks. I find that however you display the findings is a compromise. If one chooses to speak of industry-wide leading themes, the usual way, details and a feeling of finiteness are sacrificed. On the other hand, if findings are considered per actor, then, a big picture view may never be achieved, leaving the reader to ask "what was the study talking about?" etc. This is mainly why the study includes a bit of both approaches in its arrangement of findings.

There were for the arrangement, however, other reasons, too. The distinct actors seem to be governed by their own specific themes. Importantly, the arrangement highlights the study's resource or network node approach at matters. Moreover, it is simply more practical for each actor to find their own specific texts.

4. Findings: Structure of the energy industry and of the main actors

4.1 Energy industry core value network after Datahub

Figure 5 depicts the current setting of Finnish electric energy industry, and Figure 6 and its explanation in Table 4 depict the energy industry after the adoption of Datahub. As can be spotted in the figures, Datahub's purpose is to make currently separate information flows between industry actors to go through a single system. Interviewees described the currently existing system to have a spaghetti-like structure, consisting of individual point-to-point connections in the place of Datahub. Each distribution firm had to have a separate direct connection with each of the retailers. Replacing this architecture has been the main driver behind the Datahub project, the gain of which is very visible.

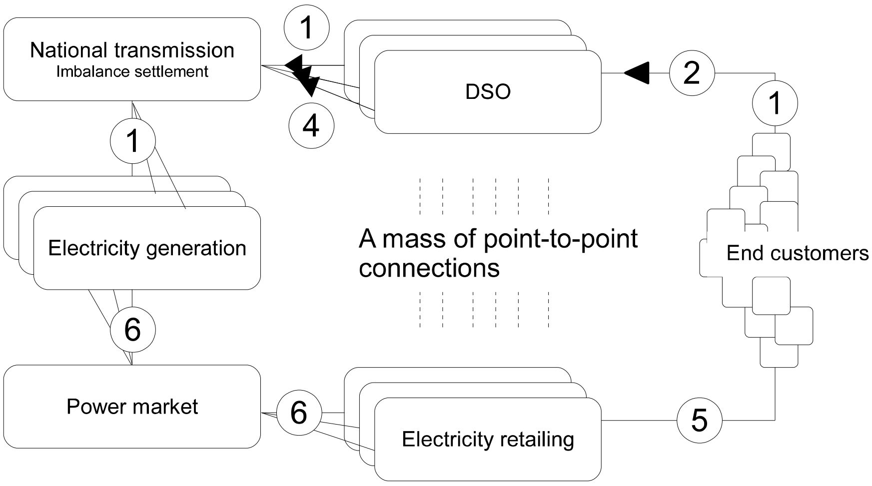

Figure 5. The current system with no Datahub. There can be said to exist hubs for physical electricity delivery and power trading but not for the information exchange between regional distribution (DSO) and retailing. Multi-connections with end customers are omitted.

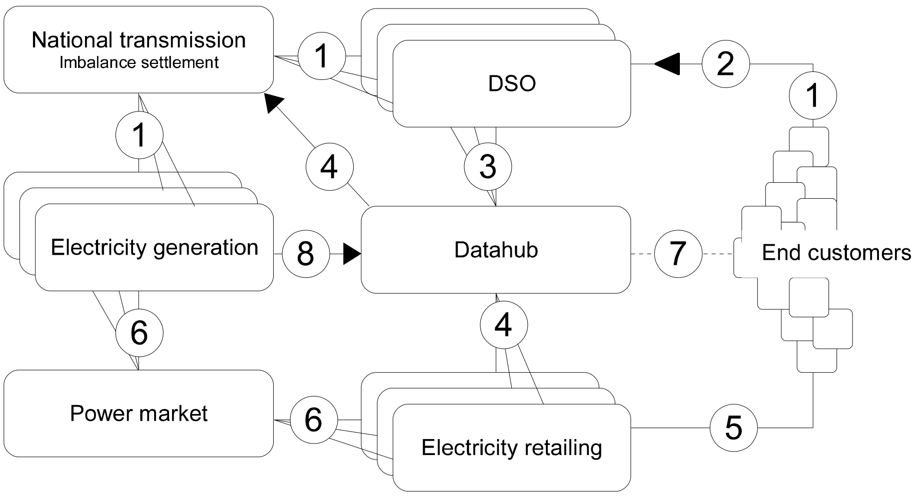

Figure 6. Energy industry's core network after Datahub around 2020.

	Explanation of connection
1	Instant delivery of physical electrical energy by the national transmission (TSO) and regional distribution system operators (DSO).
2	Power consumption values are measured for each hour and are uploaded to the respective DSOs' information systems. DSOs purchase this metering service or some portion of it from specific providers. In the first iteration of this system, the DSOs continue invoicing the end customers separately for the transmission.
3	After going through a validation process, which may involve a manual component, the power consumption data is transferred to Datahub.
4	Datahub makes the data available to relevant actors. Electricity retailers get data for the endpoints they have contracts with. Imbalance settlement is to settle for differences in the actual supply and demand values after their actualization. Datahub will also provide the data to authorized third party actors.
5	Electricity retailers make varying contracts with end customers for electricity supply. The retailers are "active" parties while the DSOs are "passive" in the triadic relationship (for more information, see Ediel (2017)). The retailers also offer a web service to the end customers to access their power consumption data.
6	Electricity generators' main business is to sell electricity to-be-generated to the combined Scandinavian power market with a lead time of one day. Retailers or wholesalers inbetween are the counterparties in these trades, covering for their contractual needs. Non-physical insurance products can be purchased against electricity price fluctuations, according to business models.
7	End customers will have a method to check data tied to them in Datahub. There is a mention in Fingrid Datahub (2016) that this functionality will be implemented by utilizing other market operators' online assets. One interviewee, however, said that Datahub could eventually have its own online service for this purpose.
8	Data from production units is imported into Datahub for imbalance settlement calculation and possible statistical uses. (Fingrid Datahub, 2016)

Table 4. Explanations for Figure 6.

To understand better what is going on in Figure 6, two distinct approaches can be used for the purpose. One approach is to think of dynamics of two flows, both originating from electricity generation. The first, consisting of material and immaterial components, would be about supplying end customers with electricity and then managing the accounting of the physical consumption. The second, purely immaterial, would be about invoicing the end customers for their consumptions in whatever designated manner and then seeing the system actors get paid. Looking at the energy industry in this manner may reveal some inefficiencies about the flows, and the study does utilize this perspective a little. Another approach would be to take Datahub along with the power market and the national transmission blocks each to represent a hub-like structure within the network, each combining a different aspect of it. The approach assumes the hubs to be immovable the most efficient parts of the network, focusing on that how the industry around them is organized. This approach, even though emphasized somewhat by the study's findings' arrangement, can be seen as a bit flawed due to assuming the hubs being efficient.

However, knowing what happens with Datahub should not be enough, it should be important to be aware of whether it is known that more structural changes will happen. But, alas, as can be seen in Excerpt 1 very practical matters and technological advances such as the increasing adoption of microgeneration were the most interesting future directions from the interviewees' point of view. This was especially the case among the purely distribution side interviewees, that single technological developments and thoughts about their effects on operations were brought up. However, retailing and metering services provider interviewees did not mention such developments as often, describing instead, e.g., an ever more costs-centered environment. Initially, these answers appear to depict interviewees' bias towards matters that are the most relevant to their organizations. But in a larger context, they might be revealing about the dynamics of the industry, that the DSOs feel rather safe and the rest not as safe as them.

Still, due to that how relaxed all the interviewees appeared to be the industry could possibly be described to be shielded from strong structure altering forces. That the interviewees were describing positive future directions instead of, say, doubting about their places characterises the kind of a mode for survival that has been sufficient for the industry actors. The literature review included one ominous case of such going by the flow ideology, denoted as path dependency, where it contributed to a bigger impact after eventual industry structure changes.

Assuming the energy industry to be indeed somewhat shielded in general, could there still be a lack of protection from lateral effects? For example, what would that pan-Scandinavian electricity retailing mentioned in Excerpt 1 becoming a thing mean? What if some aspects were to be more merged within the EU and its nations? To sum up, Figure 6 portrays the industry outlook for the short term future with no big changes on the horizon, and the athmosphere appears to be such that is not restlessly awaiting major changes to happen. Thus, even though the rest of findings develop data utilization possibilities on industry alterations, these are rather minor.

Excerpt 1. On the industry's future prospects and directions

Future predictions were very repetitive and practical, often concerning an interviewee's organization's specifics. On distribution:

Electricity distribution, interviewee K: "There has been talk of how to implement demand response. Another is the increase in microgeneration... solar panels, wind turbines... more microgeneration posing its own challenges to us... There is also the question of whether electricity can be stored."

Services, metering, interviewee E: "...a change in electricity generation, an increase in microgeneration, such as solar panels, related instability of the power grid... I do not expect radical changes from within the distribution."

A few interviewees had larger and more detailed ideas of what can be expected:

Energy regulation, lobbying, interviewee G: "We are accustomed to demand fluctuating heavily while the supply plays a reactive role. In the future, the demand has to start reacting because the supply is not a constant anymore. We do not possess large enough adjustable power reserves that could react to supply and demand fluctuations."

IS infrastructure, metering, interviewee A: "IoT [Internet of Things], improvement of home automation, electric cars possibly... For larger changes, even though we have a common Scandinavian power market retailers do not quite yet possess capabilities to operate in a pan-Scandinavian manner... The power market if it was to encompass the Europe that might lead to market concentration. Those firms that are flexible and ready to act when market conditions change while of course having their information systems in a good order should do well."

4.2 Datahub

Datahub, of which procurement by the national transmission company Fingrid Oyj (2015) was actualized via an industry cooperation project, will be a central block in the new industry configuration in 2020. Datahub's main purposes will be to relay end customer metering data to electricity retailers and to automatically complete regional power grid balance calculations for DSOs. For the purpose, it stores electricity consumption and production data for all physical locations, places, or with a better wording, all DSO grid endpoints. The information is further linked to contractual and contract parties' information as portrayed in Figure 7. Some further information is also stored, for example, information about major electric devices. This makes Datahub to have a comprehensive database which as a whole represents the national electricity consumption and production topology.

That much is crystal clear about Datahub and its purposes. But then there is that a role besides that functionality has been visioned for Datahub. Excerpt 2 contains one interviewee's idea of how third party actors could benefit of Datahub. A thing to be noted is that interviewee G in the Excerpt 2 is not very exact, simply stating that there could be something related to those matters listed, e.g., data transfer. Visioning among the interviewees turned out to be extra vague when any new kinds of businesses that could be built on Datahub were considered. Businesses that would serve the end customers in new ways or would not serve the energy industry actors at all.

One consideration that can be used to assess the position on the path to Datahub harnessing third party solutions is people's awareness of Datahub's details. The picture does not look bright from this angle either, confirming what was got for directly asking people about business opportunities. For example, people may erroneously think that Datahub could enable end customer participation in a demand response activity[13]. As it is, Datahub is simply a container to which data is uploaded in batches with a maximum delay of over 10 days[14]. Demand response is a real-time heavy activity and, thus, the fit of these two is questionable. Another common misconception tended to appear when discussing ideas related to marketing electricity deals. People were not aware end customers cannot authorize third parties to see their DSO or retail contract details in Datahub[15].

Taken together, Datahub's basis looks sound but many of the additions are in their nascency, most of all the extra-industrial uses. The findings of insufficient knowledge argue there cannot be new business formation attempts before its acquiral. It should also be mentioned that there could not be unshared very potent ideas when an interviewee was not aware of Datahub's actual functionalities.

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13 See TEKES (2017, p.16) for one such claim.

14 It is in a DSO's interest to take time to reach a certainty regarding data correctness as the Datahub requires the data uploaded to be validated and correct. As there will be at least some costs attached to correcting the data retroactively there is no incentive for a DSO to upload the batches required too soon even if the process is almost fully automatized.

15 Fingrid Datahub (2016, p.33).

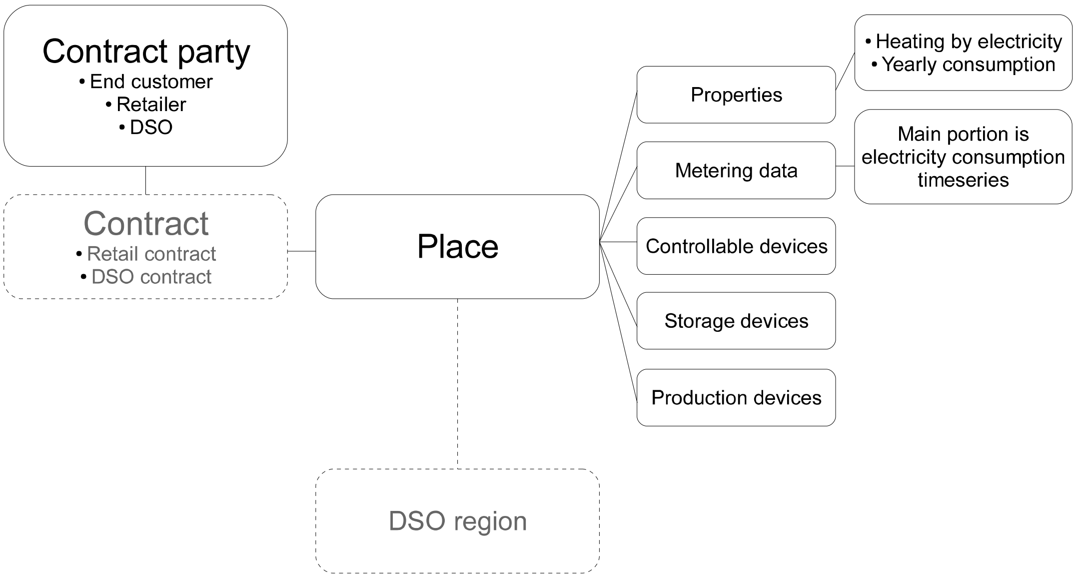

Figure 7. A representation of a portion of Datahub's intended data model. Rectangles represent object types of which there exist numerous actual objects. An actual contract object, for example, can be linked to a number of places of consumption. A place of consumption can even be an electric car. Objects have inner objects and data associated with them which are mostly omitted.The contract object is dashed because an end customer cannot authorize a 3rd party an access to their contractual details even though the information is stored in Datahub. Places belong to DSO regions which represent the limits of visibility for single DSOs. The picture is based on Fingrid Datahub (2016).

Excerpt 2. Categorizing business interests related to Datahub and a comment portraying general knowledge of Datahub.

Interviewee G framed some third party business interests related to Datahub:

Energy regulation, lobbying, interviewee G: "Third party operators can be categorized in those that aid the retailer or the DSO and in those that aid the end customer. For example, a third party can provide invoicing, debt collection, or data transfer services to a DSO that has authorized its data access. On the other hand, third parties aiding the end customer can be related to demand response, electricity procurement, or energy efficiency services."

Knowledge of what Datahub does beyond the core parties in the energy industry seem to be limited:

Energy efficiency consulting, interviewee N: "Do Datahub's functionalities include invoicing of the end customers?" [Answer: There is no such process described in Fingrid Datahub (2016) even though all the necessary information for the process does reside in Datahub.]

4.3 Distribution system operators: Relations and information systems

DSOs that feed the Datahub are pretty traditional businesses in the sense they are confined to their own things, i.e., managing regional power grids. But that what happens inside their spheres of influence should actually turn out to be rather interesting, and not only for the DSOs themselves. A DSO business, of which there are about 80 firms[16] of varying sizes in Finland, is essentially a collection of separate functions to take care of electricity logistics as shown in Figure 8. The DSOs are regulated geographical monopolies, and even though monopolies are typically linked to inefficiencies, it may bear an importance to note that the DSOs are incentivised to use 1% of their grid activity revenues in innovation activities[17].

An immediate want of mine when looking at such a collection as in Figure 9 is to find out how efficient and how far developed the operations within are. In this case, a potential perspective is to look at the IS solutions there are serving the distinct functions and, then, that how they are and how they could be linked together. This approach is quite desirable because the DSO functions appear to be heavily dependent on their IS. On the other hand, for example simply checking on people's future intentions would leave out a bit of knowing how things stand currently. To note, it was also argued more in depth in the literature review why focusing on the status of IS should be sufficient.

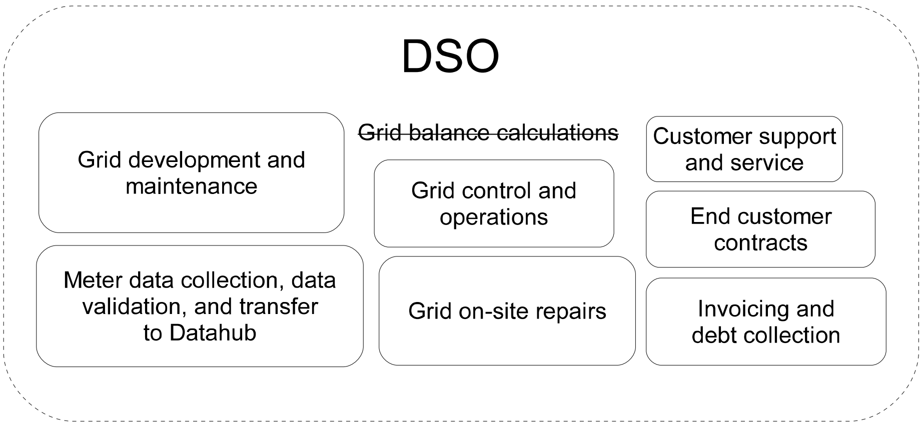

Figure 8. Essential components of a distribution system operator. Sizes of the rectangles attempt to portray how the costs are likely to divide between the functions, however, in a very loose manner. Datahub will remove the need for grid balance calculations and there may later be developments regarding invoicing the end customers. Lindholm (2016) looks further at these details in his master's thesis on one DSO case.

16 Energiavirasto (2017).
17 Energiavirasto (2015).

Excerpt 3. IS for invoicing implementation and a portrayal of DSO realities.

Interviewee F on an invoicing implementation:

IS for distributors, retail, etc., interviewee F: "Invoicing is the longest process there is, involving multiple steps, and in which automation we have invested in a lot. The current system that we acquired several years ago was then in a very unfinished state, we had to do quite a lot of development, improving CAP [capital expenditures] and integration features for three to four years.

As a result, the amount of manual work required has been reduced by a lot and as a next step we are going to take new features developed in-house in use, approaching our desired state of looking at the invoicing process through exceptions generated by it."

Interviewee B describes DSOs' operational IS realities:

IS infrastructure, metering, interviewee B: "Something [referring to Datahub] that is coming in the next two years is still far away, and what seems to characterize the interests of a big portion of the DSOs still in 2017 seems to be that how to be able to transfer harmonized customer personal information to Datahub and how those customers with missing details are dealt with."

To show an example of the DSOs' IS status, Excerpt 3 contains a description by interviewee F of their effort-filled journey to have a system to take care of invoicing. While telling the story F went on to details about how their organization's separate functions ultimately have in-house developed software solutions composed of generic blocks from various vendors serving them. To add on to that, it is probable that the F's organization represents a minority in their attitude towards in-house development. A more typical resource-limited DSO has to, or is likely to, make-do with the non-customized generic solutions available and has no choice but to suffer any operation performance related side effects.

That the firms cannot possibly choose not to purchase some amount of market IS solutions which in return do not offer anywhere near perfect fit with the needs of the business is an interesting dynamic. Figure 9 models an evolutionary path, starting from a state where a firm has to use mostly its own custom-made applications to fulfill its business needs up to a final state where there is a good fit between the IS solutions available on the market and the needs of the business. DSO businesses utilizing the model appear to be halfway on the journey to having their core IS needs fulfilled by market solutions. A similar estimate is also got by considering DSOs' Datahub related challenges which will be elaborated further in the findings.

The above discussion can be taken to point towards some general opportunities for IS service providers. However, from a data utilization perspective an argument could be posed that there is some way to go to a point where focus could be shifted to fine-tuning, optimizing, or extending the DSO functions. Right now, the DSOs are being overly pressed for just having the IS solutions in use to fulfill the basic needs. On a short term, having to implement Datahub's requirements into the IS solutions should drain the firms' resources in such a manner that any data related initiatives will have to wait, as noted by interviewee B in the bottom part of Excerpt 3. An open question is whether the current efforts for getting the basic functionalities in a good order is more of a constant loop nature instead of a one time thing.

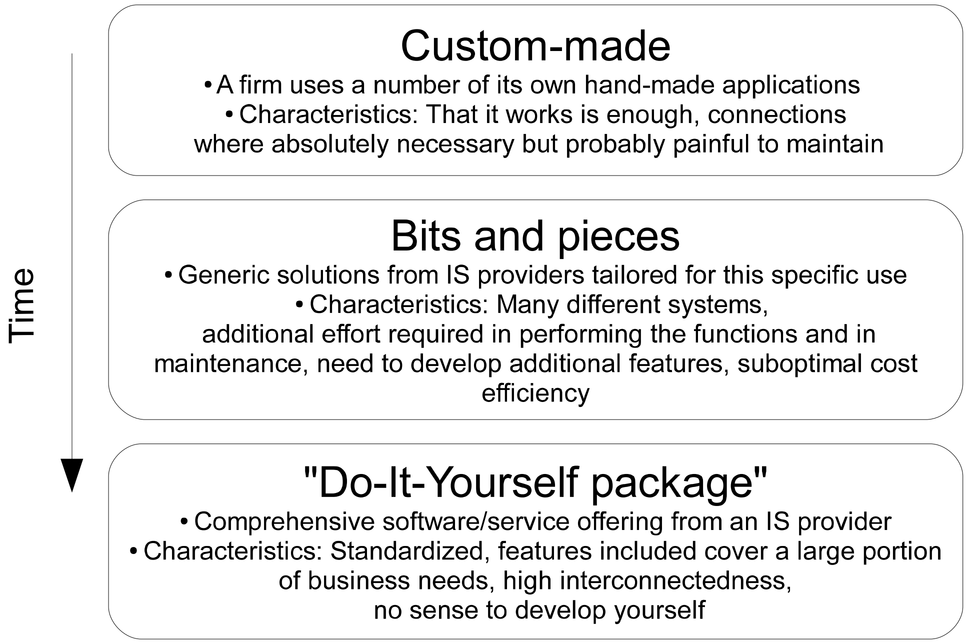

Figure 9. A portrayal of gradual development of IS solutions in use. Interviewees described individual DSO situations to be varying from a bit beyond to a bit behind of bits and pieces advancement level but take this estimate with some caution.

4.4 Metering services providers: A classic feel

Meter data collection, data validation, and its transfer to Datahub constitute one of a DSO's main functions or responsibilities as displayed in Figure 8. In the original industry value network Figure 6, that what this function comprises was contained within the circled numbers two and three. Because the function is a central component to understanding Datahub and there are interesting data utilization related considerations to it beyond a DSO's sphere of influence, it is the only DSO function that warrants that evidently a separate description. The function also concerns a considerable chunk of a DSO's cost and IS structure.

To be able to perform the function means a DSO has to at minimum purchase the required metering hardware but then there is some variation with that how those are connected to firms' IS architectures. Currently, the majority of the DSOs purchase meter data collection as a service, so that consumption data is fed by a service provider to a DSO system performing data validation and its further transfers. But that is not the only option. There are also those DSOs that have purchased a license to the meter data collection software and run the service with their own resources.

Figure 10 displays an outline for how the function is likely to be handled with Datahub. In the picture, Datahub could be understood as a lake where all single DSO data streams, of which only one is shown, empty. These streams begin with data collection from individual meters, involving a narrow pipeline through which hourly timeseries data[18] is transmitted to a central database. The data is further refined and enhanced, in some cases flowing through multiple systems, eventually emptying into Datahub. The number of data fields linked together increases through the process, reaching its maximum at Datahub. It is important to notice the narrow pipeline represents a physical limitation to data utilization ideas involving heavy data transfer or low latencies with masses.

More importantly, however, Figure 10 outlines two alternatives for the final stages data transfer to Datahub. The currently in use IS architecture, involving a DSO-controlled data validation system, may be unnecessarily complex and suboptimal. It is not desirable for every single DSO to have their own implementation of data validation procedures as per the left route in Figure 10 when it is not a trivial matter and may change due to, e.g., regulation.

Especially those DSOs possessing an IS architecture of many imperfect generic solutions might find themselves wondering why they have bothered, as pondered by one DSO interviewee. Reducing the number of information systems in use could be worthwhile for a bigger, more focused player to improve aspects that were not cost-effective enough from single DSO perspectives. That the metering services provider firms operating in this area have not already gone forward with such efforts gives them a certain classic business imperatives feel.

18 The data contains hourly wattages, electricity supply quality information, i.e., data about voltage fluctuations, and, if measured, reactive power data.

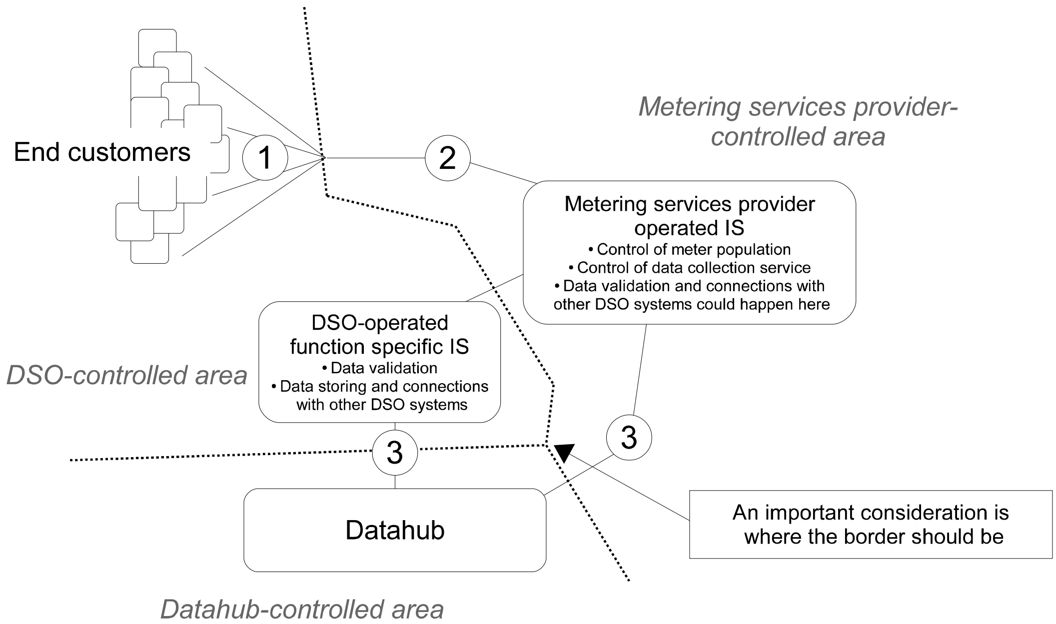

Figure 10. Flow of metering data from physical locations to Datahub. The figure displays two alternatives for the final route to Datahub. It is argued the right route is more optimal. Explanations for the connections are in Table 5.

	Explanation of connection
1	Individual meters are connected by various methods, e.g., radio, powerline, or by a cellular connection, which can include a hub inbetween single meters and the collector system. The meters include switches that can be used for end-point control but there is no direct feedback features other than the change of power consumption measured by the device itself. Moreover, some communication channels, such as powerline, pose challenges if large amounts of data were to be transferred or low latencies for masses were desired.
2	Collecting and transferring meter data to a central database is a time and resource-intensive process. After the data is collected it has to be validated in a not too simple process and any unavailable data values have to estimated.
3	The debate is about where data validation should happen, within a DSO's systems or within the metering services provider's systems. The former is not the most efficient solution but is the current setting. Depending on that detail, one of the final routes to Datahub is chosen.

Table 5. Explanations for Figure 10.

4.5 Electricity retailing: Knowledge-based

Discussed Datahub and DSO aspects land in the physical electricity delivery and its accounting related half of the energy industry. The other not yet discussed half concerns the collection and sharing of revenues with the members of the value network. The part consists of brokerage businesses and power market details, involving aspects such as contracts of various types, inbetween actors, and heavy planning activities. Even though the divide does not totally respect the borders of the distinct actors, DSOs billing for electricity delivery separately for the time being, I believe the kind of an abstraction can be valuable.

Of the relevant actors, electricity retailers, operating the closest to end customers, give a decent entry point to understanding how the network actors get paid. In contrast to the DSOs, it does not make sense to map the electricity retailers according to IS systems in use as there are only few. This is exemplified by that they may not even need a dedicated metering database after Datahub. Hence, it should be preferable to consider the IS in use simply to be a representation, or in an execution role, of some underlying retailing business logic. However, there is a question of how much depth there actually is to that business logic. Interviewee L's description of the business in Excerpt 4 deciphered by the study's theory hints towards a limited extent of knowledge-based advantages.

Figure 11 depicts a retailing operation and its two logic requiring aspects more closely. Electricity purchasing and reselling logic should play the main role in determining how successful the firm in question should be. As mentioned, the figure intentionally leaves out any trace of the IS infrastructure beneath because that very much represents the business' fixed costs. Not to simplify and categorize electricity retailing too much, however, it could possibly be about service providing, too. For example, people have been thinking about various energy efficiency related services attached to electricity contracts.

To understand better what kind of considerations there are to a retailing business, one decent way is to put activities related to the logics in Figure 11 on a timeline. The earliest of the activities is that of making electricity delivery contracts with, say, domestic clients. This piece of the process appears to be quite well automatized, typically happening through an online service. The products that are sold have either a somewhat predetermined price for the electricity or have it vary by some factor, such as the time of day, season, or the manner of generation. A product that has its price tied to the power market, offering the retailer a simple margin over the market price, represents one end of the spectrum when a fixed price is the other.

To cover for its contractual needs, a retailer has to purchase the physical electricity it has agreed to deliver. This is where firms' practices differ. They can choose to go by a risk-averse route and purchase the electricity the moment a contract is signed, as in Excerpt 5 for two years ahead, or for a similar effect buy market derivatives against price fluctuations. The other option is to wait and see, perhaps covering liabilities to

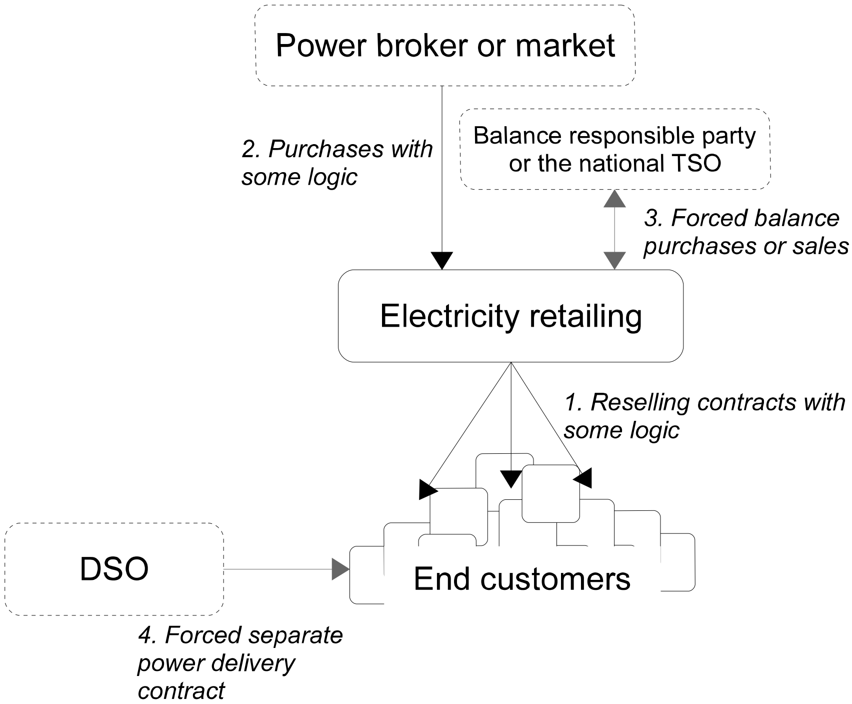

Figure 11. A retailing operation does electricity deals beforehand and afterwards acquires the product, both with some inherent logic. After the actual deliveries, it still has to balance the scales. An end customer has to have a separate contract with a DSO for electricity delivery.

Excerpt 4. Describing electricity retailing businesses.

Senior energy broker, energy trading, interviewee L: "I see electricity retailing as quite a bulk business with marginal profits. Differentiation seems difficult and some alongside service offerings should be attempted, but I am unaware of any successes. The number of retailers will decrease."

Excerpt 5. An example of electricity purchasing logic.

Product manager, electricity retail, generation, interviewee H: "Let's say we do a two-year deal with a customer. Typically, after signing we acquire the required electricity for the two years. Of course, this depends on a firm's risk management – how much electricity, a third, a half, or even all, is procured in advance."

some extent, purchasing the required electricity one day before the delivery, according to the design of the Nord Pool Elspot market[19].

But that is not all. Nearing the time of delivery, electricity can still be traded within another Nord Pool intra-day market. After the delivery, because a firm cannot know beforehand how much electricity exactly will be consumed during any given hour it has to balance its purchases and deliveries after their occurrence with the national TSO. These purchases or sales are unfavorable, pricing depending on taken grid balancing measures. Also, there is one last market operated by the TSO which allows participation in these grid balancing measures, requiring a large enough adjustable load or a generator with a fast, less than three minutes, reaction time with a feedback capability. Some retailers have shown interest to participate in this market.

Having described that how the other half of the energy industry is structured, a couple of interesting questions can be asked. How would it go if the whole electricity retailing portion was arranged in a more light-weight fashion? What kind of concepts and information systems would then be required to serve the end customers more directly? Some questions can be pointed at the power market, too. At the moment, the day-ahead market functions as an auction, giving one price for all. What if it did not operate in this manner at all or, more interestingly, what is the likelihood it will stay the same in the future? Answers to these questions should tell a lot about data utilization opportunities but, I would want to stress, even asking these questions is reaching for the limits of the study's corpus.

19 For more information, Nord Pool (2017).

5. Findings: Themes underlying actors' opportunities

5.1 Datahub

5.1.1 Third party data access may require an infomediary

To enrich the industry illustration of the previous chapter, specific themes underlying data utilization opportunities can be described for each industry actor. Beginning with Datahub, considering industry actors' access rights to data stored in it creates a unique perspective to understand what kind of opportunities there can exist to it. Consider that information readily available to each Datahub connected actor is the information they themselves uploaded or have an ownership of. A purely third party operator would not have an access to any data other than those given for statistical uses. The point is no new knowledge can instantly be acquired with the default Datahub access rights[20].

According to that insight, the key to harnessing Datahub successfully revolves around acquiring access rights to otherwise unavailable information and dealing with privacy concerns. Assuming various actors, businesses, would like to have an access to Datahub's data, how would they go about it? Should everyone collect separate licenses from a mass of people and should these licenses be stored also separately in Datahub? At least, the interviewees appeared to think so, but some doubts about its straightforwardness can be asked. I do not think there was a consensus about whether collecting thousands of third party end customer authorizations would be allowed, agreeable. Then, what if some limited access could be given to a not so trustworthy third party actor, will Datahub be able to satisfy this need? These questions point towards a need for an infomediary, an information mediator. It would collect, hold, and control data access authorizations, facilitating the use of data.

It might also be worthwhile to say a few words about possible data access methods, which include some not naturally thought about options. Excerpt 6 contains interviewee A's description of how a Datahub registered actor can simply authorize themselves, having a non-digital license from the owner. Another similar method would be for, e.g., an electricity retailing firm to collect authorizations and their resale licenses in its electricity contracts, but this looks a bit distant. The default method to be most commonly used, assuming a purpose, was thought to be authorizing through an online identification method.

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20 One exception seems to be that retailers will get to see DSO contract information for their customers, but the DSOs will not see retailing contract information (Fingrid Datahub, 2016, p.33).

Excerpt 6. A trusted Datahub registered actor can do a self-authorization.

Interviewee A had studied Datahub's upcoming implementation:

IS infrastructure, metering, interviewee A: "As a Datahub registered third party or an electricity retailer who has promised to behave well, you can ask a person, say in a local electricity deals marketing event, for an authorization and the person simply needs to say yes maybe including a written note. [The Datahub party authorizes themselves.] If there is a reason to suspect misuse, then, the notes could be reviewed."

5.1.2 Should Datahub have had a bigger role?

A second data utilization opportunities underlying consideration to Datahub concerns its limits and role. Consider that whether Datahub is seen as the best default data access point and by whom, assuming it contains the data wanted. For an extra-industrial third party this was believed to be so as Datahub represents the frontier to where vital energy industry information is collected and from where it can easily be accessed. A services provider to a DSO should also prefer to connect to Datahub instead of a client DSO's systems directly, if feasible. The reasoning is that the firm could then expand slightly more easily and, perhaps more importantly, it would operate in a more controlled fashion. But, finally, would there be merit even for a DSO firm to use a central information system such as Datahub inbetween its information systems?

Elaborating on the question a bit, the non-real-timeness and data correctness design characteristics of Datahub 1.0 would make it ill-suited for the purpose, DSO operations requiring the opposite. But, from a system perspective, a development or an alternative such as that would achieve introducing a huge chunk of standardization into the DSO population. As the DSOs are currently constellations of separate IS solutions, a centrally operated IS would simplify the job of IS services providers because the applications in use and their interfaces' architectures would become very similar. The DSOs, on the other hand, would be able to pit the IS service providers effectively against each other while holding the option to sign out of existing contracts or change suppliers at will. This sounds rather delicious, almost as a dream come true.

Such a visioned alternative Datahub could indeed be a clever vehicle for driving DSO standardization. Perhaps so much so that thinking about its implications would open a whole new rabbit hole into visioning how the energy industry could alternatively be structured. As a streamlined IS architecture was in the core of this alternative, this consideration is one visionary example about how data utilization's journey to a front row seat could be hastened.

5.2 Distribution and metering services providing

5.2.1 A vision: Unlocking possibilities by liquefying information resources

Proceeding to DSOs, I had a hunch that there could be something to intra-DSO data utilization. With that as a motivation, I asked interviewees to describe what DSO functions "would like to know", i.e., to get a grip of whether the interviewees could come up with some rapid data utilization opportunities. It seems that liquefying information resources could possibly have a role within a DSO business. This refers to data transfer from one function to aid another but can also be understood simply making the data more available, facilitating its use. That, however, appears to be the limit of wider usage ideas that people were able to come up with for intra-DSO activities. Other than that, people were mentioning and expecting just tiny improvements. It was repeated that Datahub will not be much help as it should not be able to provide much useful new information.

To elaborate on the liquefying of information resources idea, Interviewee J describes in Excerpt 7 their experiences of how they currently pass a few data fields from one function to another. But that description is not exactly very comprehensive, scratching a surface figuratively speaking. J explained that even though it would be beneficial to pass metering data to their power grid information system no such connection has been made for the time being. Quite clearly, if the connection had a large enough associated benefit it would have been made. This loops back to that there is a tough competition for data utilization ideas that could provide more than just a little bit of extra value for, typically, a lot of hard work.

However, one interesting angle to look at data utilization might be that it should be able to provide a degree of certainty that a function or a process is fully optimized. In the latter part of Excerpt 7, J describes a process of how a report turns into a physical repair activity, quite similar to that of emergency calls, noting physical grid repairs are a major source for operating costs. The statement having been so common and repeated among the interviewees could be taken to hint that the DSOs are unsure whether their it related processes are all optimal. Creating a better understanding of the process through data, be it business or meter data, could help in achieving that peace of mind.

An eye-opener for what data could actually provide for the functions, and the processes within, was the description how proactive grid improvements are put forth, a story also shared by interviewee J. Interviewee J explained that when they were to check transformer shortfalls in their power grid the effort had to be done by manually analysing data from the cold weather season of January 2016, leading to an order of a few bigger transformers. The idea that the story brought up was that even though the system contained all the data required for the conclusion it was not smart enough to produce it automatically. If it was, in addition to freeing employees of the analysis effort, the information would have been available sooner and there would have also

Excerpt 7. A description of how meter data is currently utilized and a statement about costly physical repair work that many interviewees, some not even representing DSOs, brought up.

Interviewee J has experience of utilizing meter data in DSO operations:

Electricity distribution, interviewee J: "It [utilizing meter data in operations] is challenging at times. Meters and meter data collection systems have each been built according to their own ideas. In our current implementation a few basic error types are automatically passed from meter data collection to a task control system but the process has been hindered by unsupportive first generation smart meters. Data about electricity supply quality is actively brought into various reports and standard [DSO-business related] compensation calculations."

A process description for handling grid error reports. The need to control physical grid repairs was a very common and repeated statement:

Electricity distribution, interviewee J: "We use a three-stage process for managing grid errors. In general, we have a service desk receiving error reports and then we have people responsible for filtering and analysing the errors before passing them on to contractors. Controlling of what gets passed on is super important."

Excerpt 8. What appears to be the pinnacle of IS projects within the interviewees.

Interviewee F describes their smart database project:

IS for distributors, retail, etc., interviewee F: "We have been closely working on our Smart Database project for the last two years, concentrating all data from different systems into one place. The systems concerned are the grid information system, its support systems, the customer information system, the metering data information system, the accounting system, the project management system, and even data from production facilities is imported.

We have been doing a lot of data analytics with some proper tools and what we would want to achieve is increasing data analytics persons' business know-how. So that there would be more meaning for the data, to be able to spot indications from it."

existed a reasonably sound basis for that no other part of the grid would require attention.

Entertaining the thought of an automatically data analysing system may still belong firmly in the future but, still, an idea of a system allowing safe operations closer to physical limits is quite intriguing. This might be something that interviewee F is sighting on the horizon when he describes their ongoing smart database project in Excerpt 8. The project interviewee F describes is a similar central data collection effort to those known to be under development in firms in many other industries[21], showcasing for what kind of a future to be on the look.

To link this discussion about having a peace of mind to the rest of the study's discussions, considering a concept of flexibility might be interesting. Flexibility to be able to tune processes optimal on the go, to make an optimal process actually a moot point if they can easily be changed after a better configuration has been found or has become available. From an IS perspective, that means how easily the systems in use are able to fulfill possible new wants. This ties nicely with the earlier discussions of where, for example, the DSOs are with their IS architectures, industry's directions, and what is intended with Datahub. Interviewees were in general excited about the idea of bringing in data utilization but did not know where to look and for what. This specific discussion about the DSOs attempts to give an answer to those questions.

5.2.2 Deepened cooperation should be a possibility

The above attempted to clarify a future vision for the DSOs but it did not include much of a perspective from their service providers. As it was earlierly illustrated that, for example, a metering services provider for a DSO should have already attempted to bring in cooperation, a question of why it has not remains. To show a light on the dynamics in play, Excerpt 9 contains a citation from a metering solutions salesperson, describing aspects valued by client DSOs. Besides the rest of the aspects mentioned, true costs of an offering is seen as by far the most important. It appears that the modus operandi for the DSOs has been to put up tenders for specific services, defining beforehand what kind of a solution, usually the most cost-effective, should win.

It does not seem to leave much space for a metering firm to be more than what was requested, more than a simple hardware supplier. Even though its service offers have to include sizeable IS components. From an R&D perspective, such as that how to enhance data utilization, the situation looks especially dire as any idea should be directly translatable into a cost advantage in the typical tender rules. This is quite a disincentive to partake in a general R&D activity in the first place. Even if a firm wanted to invest in R&D and wanted to position itself as an actor offering IS solutions instead of being a pure hardware supplier the decision appears to lie very much within the DSOs. It is them who determine what kind of system configurations they are willing to receive, in essence, determining the possible extent of cooperation

21 Term Master Data Management (MDM) characterises these IS efforts.

efforts with their strict tender policy.

However, there might also be another angle to look at this. It was mentioned in the theory portion of the study that there may be some truth to firms following patterns or paths confirmed by a successful past. This would be a theory of evolution and survival of sort. In this case, a metering services provider has been taught to follow the rules set up by the DSOs, but now the discussion puts up some uncertainty on whether that is the most optimal for both. Perhaps it would make sense for a metering services provider to take a bit of the initiative, separating and compartmentalizing its offerings to be able to show value beyond that what was requested in the tenders. The result of this, that what this really aims at, is to look at a way forward, similar to that of the DSOs'.

Excerpt 9. A metering services provider interviewee describing some desired IS product characteristics.

Important system characteristics:

Sales, metering systems, interviewee C: "Easy operations, cutting TCO [total cost of ownership]. A big portion of costs originate from having to send someone to field. Systems have to support finding problem points, touch the right things, and not react to something that does not need reacting. For example, if a customer cuts the power off themselves voluntarily we know not to send anyone to do a field check."

Client requested system characteristics:

Sales, metering systems, interviewee C: "There is always something. That we can offer a managed service type of a solution to have an efficient sales process. Visualizing data, putting things on a map.. seeing is believing. Information security. Each country has their own integrations and system portfolios."

5.2.3 An anecdote of capability limits: Utilization of raw meter data

When given a chance, as a part of the study, I wanted to look at the very details of specific data utilization ideas. As I thought there could be something to meter hardware and enhancing its functionalities with data, interviewee C was helpful in probing this hunch. Surprisingly, in Excerpt 10, interviewee C describes that meter hardware currently possesses only a very limited number of self-diagnostic functions. There are no fancy modern algorithms creating insights from the data that goes through the device.

It may be so that these properties have not been developed because of the DSO determined landscape of operations. But one other possible explanation is that the expertise required in development is too different from that currently residing in the firms. Considering the existing academic literature has also mainly shown interest in specific fields of raw meter data, sometimes even sharing a theoretical lense, this appears to be a somewhat unscouted region.

To portray a possible future research direction, if one assumes a case of a relatively low amount of individual loads connected to one metering point, would it be possible to identify a single electric device in use by its unique electricity consumption signature's effect on the aggregate timeseries? If possible, that would open the door to some further ideas but it would at a minimum require tuning the meter hardware to measure electricity consumption per second. An R&D restrained firm could develop an idea like that by encouraging a third party, e.g., a start-up or university people, to take a look.

Excerpt 10. Meter hardware's diagnostic properties.

On what kind of a role diagnostics play in meter hardware:

Sales, metering, interviewee C: "There is some but a meter's own diagnostic tends to relate to it surviving power cuts and other unusual circumstances. It is yet to be seen that other extra diagnostics-related ideas become materialized. It should be possible for a meter to do much more regarding the characteristics of the grid it is connected to."

5.3 Electricity retailing

5.3.1 Simple data utilization ideas appear to not work

Of all the industry actors, electricity retailing may be the case that best exemplifies that how energy industry data utilization should be approached. One could assume electricity retailers are those that stand the most to gain from, for example, the data access enabled by Datahub. But, oddly enough, the opposite was the consensus among the interviewees, that there are not very many good data utilization opportunities.

To illustrate that position, there was thought to be not much benefit from using very fine-grained data when the most sought after piece of information is an aggregate, that what is the price of electricity in the future. The variable depends on factors such as aggregate supply, demand, weather, and the whims of regulation which are not something an atomized dataset brings any insights into. It should turn out that unlocking data utilization opportunities, if there are any, requires them be accompanied by some amount of other changes.

Starting from the beginning, one concrete idea based on Datahub was that future clients' individual electricity consumption profiles could be used to better estimate their true costs to a retailer. This, however, appears to be a practice too insignificant to matter. There was no interest for a retailer to know, for example, that a client is someone doing night-shifts, and thus consuming his or her power mostly during the odd hours with cheap electricity. Simply put, the retailers deal in megawatt hours when individual client contracts concern a unit that is a thousand times smaller. What does bear a significance to them is their business clients and their consumption profiles are already well known.

Another potential idea concerned a mass of people who had given an access to their Datahub information for marketing purposes. A retailer would want to use that information to see when people's deals expire to offer better terms. But it will not be possible as end customers cannot authorize third parties to look at their contract details. The idea would require an infrastructure base to collect customer authorizations, and perhaps even somehow reroute contracts through an intermediary to be able to see the details, making the idea unlikely to materialize. Not to mention that an actual advantage versus costs analysis points strongly in the negative. There is only that big piece of the pie on the retailing table for the players to be shared.

5.3.2 "Changing the rules" to enable new data utilization opportunities

It is evident where the discussion is about to go. To note, retailers' position within the industry, reason for existence, seems a bit unstable, uncertain. They are being squeezed. As a result they have taken to, e.g., merging operations and similar practices. That going by the flow is again another instance of industry prevalent path dependency phenomenon, that there is a lack of attempt to find an out of the box solution. What if, metaphorically speaking, rules of the game were changed, could there be relief to retailers' unclear state of being all the while enabling some totally new data utilization opportunities?

One key idea might be related to solving the Gordian Knot of bringing back together the already separated invoices of delivery and of electricity consumed. There is certainly willingness to this among the retailers to take care of both but the DSOs tend to strongly disagree. But what if retailers pushed for doing business in complete unique personal energy offers that will be possible with Datahub? Offers that are calculated on a per case basis with the information available in Datahub, perhaps also utilizing other known customer history.

But that kind of a thing would not quite have that total offer feel when people would still be getting separate delivery bills, one for each of their places of consumption. The argument gets more depth when the fact that a customer has to have a separate DSO contract, sometimes many, is considered. Add in that the DSOs are considering delivery pricing alternatives as the amount of energy transferred by the grid is decreasing. Their idea has been to transfer to a "power-based"[22] pricing scheme, which is basically still the current system of mainly paying for the amount of energy transferred but on steroids. It would exponentially penalize for electricity consumption peaks, making it extra important for customers to equalize their electricity consumptions.

22 In Finnish: Tehopohjainen hinnoittelu. For more information, see Tuunanen (2015).

Look at that setup as a simple energy consumer with multiple places of consumption all with the two contracts each having their own heavy pricing particularities and what you get is a real mess. The consumer will not be acting optimally in that scenario due to the sheer amount of complexity. This creates a reason for the existence for an actor that can give one price for the energy, it and delivery, with clear terms on how the price is determined. Then, with that given clear ruleset the end customer can attempt to use hardware, e.g., solar panels, and software to control his or her energy bill. What this would mean for the retailers and the DSOs is that now it would be their situation that would be that much more open and complex.

Perhaps there could be a development similar to that seen with telecoms that original electricity delivery service must be sold at a fair price and the end customer can purchase the service from any provider. The point is that the retailer should be able to purchase the delivery service and resell it to the end customer in a package deal, which might put data analysis in a larger role. The setting would mean larger changes to DSO operations as operators having grids in both urban and rural areas would not be able to charge rural rates from the unlucky urban customers who cannot at the moment choose their DSOs. In essence, the idea enables customization of electricity delivery tariffs via retailers.

5.4 Auxiliary energy services

As the last industry detailing topic, a few words could be said of energy related businesses there are operating on the outskirts of the core industry network. There are businesses that offer, for example, electricity wholesale or procurement services, energy efficiency services, and electricity usage reporting for clients possessing a catalog of properties. As can be seen, the firms take care of some specific challenging portions of their clients' operations, in a similar manner to IS services providers.

To elaborate the listed service providers, an electricity retailer or a large firm may have dedicated its electricity purchasing logic to such a third party. As another different possibility, a client may use such a third party's service to manage a multitude of properties each with their own electricity contracts. The same client may also be interested in being aware, knowing for certain, that properties operated by him or her do not consume an unnaturally high amount of electricity. Perhaps the client is also interested in finding ways to tone down electricity consumption levels, which is one service the mentioned businesses offer.

These examples bring forth several considerations. One industry-wide implication is that core network parts, electricity procurement in particular, that are being operated under one umbrella should be able to change faster than in a scenario where coordination is divided. It also already embraces the logic of perfecting an aspect through being able to focus, which was seen in the future for a metering services provider. A second, quite different, matter is that how much overlap there will be with the various services and Datahub. An electricity client should have a view in

Datahub to look at his or her various places of consumption which, at the moment, is one of the firms' service offerings. One interviewee, representing a firm offering energy reporting services, said on the question that they acknowledge their exposure to the risk but consider it rather low. Their reporting service should contain that many more features that whatever generic implementation Datahub will have should not be able to satisfy the needs of their specific customer base.

But the interviewee appeared to be a bit uncertain of whether the statement is totally correct. Regarding Datahub's upcoming implementation, it can come in one of two flavors, a minimal effort one and the other attempting to accomplish more. One interviewee with a role in the Datahub project in Excerpt 11 states that which one is going to be chosen is under discussion, explaining the latter is lucrative to fully exploit Datahub's possibilities but it comes with additional costs. The person also visioned that the future for Datahub might hold more advanced energy reporting, efficiency, and invoicing related services built on its interface. One might think this would be a perfect opportunity, for example, for the firms in question to offer solving Datahub's service implementation by offering their solutions to be the default. But firm representatives said they are not in business with domestic customers or have too many wishes of.

A natural extension to a future services overlap discussion is thinking what kind of a complementary role the firms' services can have. It was repeated many times by interviewees in retailing and distribution that there could be more advanced energy reporting and efficiency related services offered alongside normal electricity products. But nothing very concrete was mentioned by anyone. Considering the energy reporting services interviewee said they were just following the industry scene, it is unlikely there will be approaches in this regard in the short term future.

Excerpt 11. On what kind of an access there should be for end customers in Datahub, and implications for service providers.

Interviewee: "To achieve as large cost savings as possible for every actor involved and because of regulationary reasons, there has to exist a basic functionality for energy reporting. But right now that whether there should be a separate portal with user identification or should every actor take care of their own customers is under discussion.

My opinion has been that the former is the way to go because, for example, user identification is needed no matter what. Likewise, Datahub can offer energy reporting to end customers. Then, when an actor wants to differentiate from the mass it can offer more advanced services through a Datahub interface, which will be implemented with a certainty."

6. Findings: An industry outlook

6.1 A model, its implications, and interesting future industry regions

Figure 12 depicts the main findings of the study, creating an outlook of the energy industry landscape from which data utilization-related projects would have to stem. The picture lays out identified themes that are likely to be first encountered with data-related projects in the depicted areas of the industry. As such, they could be understood as displaying how incompatible each of the areas is with data utilization efforts. The figure also contains a few opportunities and, notably, some of these should become available only after the defining themes portion of the area has been dealt with.

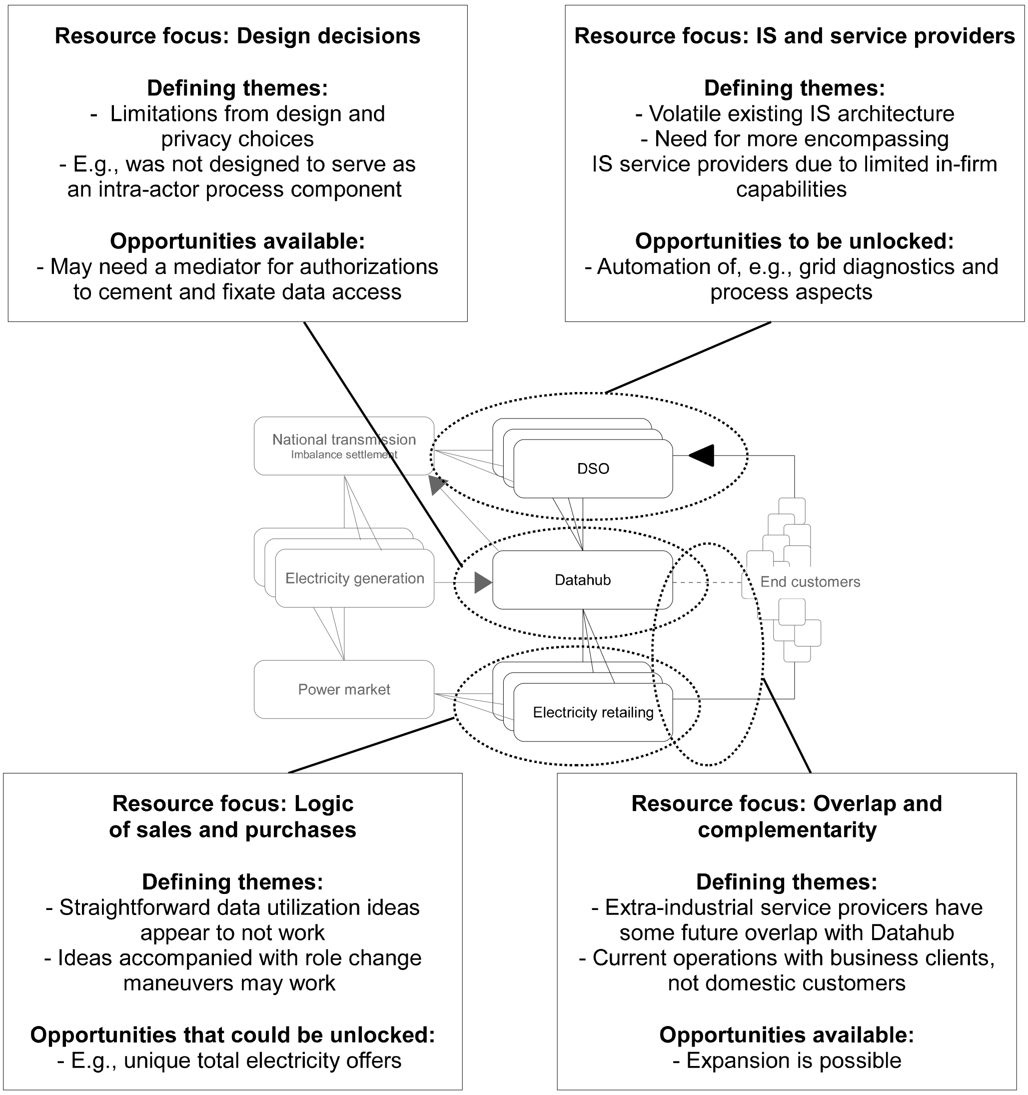

Figure 12. Study's main findings in one picture. Resource foci are identified important aspects for each industry actor or area. Themes are first encounter aspects when data-related projects are thought of or put forward.

One immediate observation on Figure 12 is that it does not exactly frame a grand plan for energy industry data utilization efforts, and that the opportunities identified are rather conservative and attached to each of the respective circles they describe. This characterises the industry still being in its nascency in regard to data utilization. What might describe the current data utilization athmosphere within the industry the best is that people can be excited by the concept but they do not really know what to think of it. That is, people lack a proper way to approach the matter.

The motivation behind the model in Figure 12 is to offer one such way. Furthermore, it can be used to explain people's unawareness by considering how expansive blocks to data utilization endeavours the listed themes are. For example, is it any wonder DSOs may not immediately see much use for data when what they right now would like to do the most is to streamline their IS architectures? Streamlining must come first, and data utilization comes on its turn. As another example, electricity retailers assumed a rather minimal role for data utilization, most of the simple ideas not working. But are they being held hostage by their assumptions of the surroundings staying a constant? Should changing electricity sales logic mix up the importance of data utilization as hypothesized and, in essence, unlock opportunities?

That what Figure 12, and hence the study's content, is actually about is portraying different kinds of barriers which must be overcome if data utilization is to be desired. To this, Table 6 adds a possible categorization of the barriers, exposing their differing properties which can be used to assess whether and how the industry should evolve towards a more data utilization friendly state. The three categories in Table 6 trace the barriers to primarily willingly made decisions, to more temporary obstacles of lacking base resources such as fragmented IS, and last to more difficult to amend deficiencies the first two categories are not sufficient to explain.

For example, Datahub viewed by the approach is pretty barred from meaningful improvements in regard to data utilization in the future as the first category in the form of hard-to-alter privacy decisions define it a lot. One could say Datahub was designed to serve a certain function with certain requirements in a certain environment. Some ideas, e.g., Datahub to be more fully integrated into stakeholder processes, would have required a fundamentally different environment, base ideology, or a starting position to actualize, so they will not be possible. If these opportunities were imagined to be on one side and the current system state on the other there would now be a rather incrossable void inbetween, representing that what was not thought about or thought to be possible.

A similar situation might exist with electricity retailers, them being sceptical of data-related opportunities all the while not really knowing what their future roles will be. There could exist interesting directions for the retailers to take but possibly the limits of thought make for the biggest barrier. Hence, the last category seems to concern a lack of imagination but also it must concern things such as a value network's inertia. Consider that, e.g., decisions relating to Datahub were done and agreed to by the industry collective, which inevitably makes it so to say a very heavy object. Once put to move, a heavy object does not easily change its course, which characterizes Datahub and should characterize electricity retailing business operations aswell. For this reason, it should be important for the retailers to choose an optimal initial movement direction.

According to the barriers insight, data utilization opportunities vary a bit within the energy industry. Opportunities related to the DSOs appear to be confined to their operations. Opportunities related to electricity retailing appear to concern a larger region, the axis of power market, retailing, and end customers. Opportunities related to Datahub have an emphasis on the role it was designed for, and it appears that additional value creation for end customers should be simpler than for the other energy industry actors.

Table 7 lists these findings as three regions within the energy industry to look after along with a handful of hypothesized factors present at business formation attempts within the regions. Some other factors could definitely be picked or derived from the earlier themes, so take the listed ones with a grain of salt. Table 7 also lists possible limits to competition for each of the three regions. The competition limits stress that some actors are far better suitable or incentivized for some region attempts from the get-go, but then there is also the one indeterministic region near end customers where everyone's estimates of the potential matter the most. Limits to competition after a new business actualization is a factor affecting that how lucrative each of the regions is for new business attempts.

Theme categories	Represents	Examples
A border due from made choices	Artificial limits	Consumption data is private
An effect from base resource quality	Current limits, easy to amend	Fragmented IS, lack of data analysis expertise
A void not explained by the other two	Lack of "higher-order" resources, difficult to amend	Datahub was designed according to a certain idea; No retail uses acknowledged for Datahub's data

Table 6. How Figure 12's themes could be categorized.

Interesting regions within the industry to look after	Factors affecting resource formation in a region	Ex ante limits to resource formation	Hypothetical ex post limits to competition
Within DSOs: Service providing	Service transferability, i.e., that the service can be expanded to many DSO clients. "Advancedness", i.e., how much effort is truly required, for example, to unlock automatisation gains.	A classic barriers case: A potential service provider must possess a discussion channel with, say, a pilot DSO client. Solutions require in-depth expertise from multiple fields.	Difficult to copy an expansive solution
On the power market, electricity retailing, and end customers axis	Whether the network structure is altered by, e.g., the retailing business model changing or by larger developments.	A skewed case: Retailers have more reason to seek new resources or a configuration.	Established position, business size
Inbetween end customers and Datahub	Adoption of new technology, e.g., solar panels, batteries, controllable home appliances. General compliance of software and hardware. Implementation of Datahub.	An indeterministic case: Distinct actors should end up at different value estimates.	-

Table 7. Interesting data utilization relevant regions within the energy industry to look after. Each region is accompanied with a hypothesized set of factors present at new business attempts, i.e., factors affecting resource formation and a description of limits to these new business attempts, i.e., limits to competition before and after resource formation.

6.2 Showcasing the built model: A demand-response scenario

During the interviews some new business scenario formulation was attempted but most of these ideas were figuratively shot down before they could grow wings. Typically, a response such as "that has been done before" was given or the idea itself was based on incomplete information. It appears as strongly predicted at the study's onset that understanding the energy industry in details is very much the basis for being able to pose plausible new business ideas.

Figure 13 contains one of the scenarios discussed, formulating an automated demand-response operator business, which hopefully offers at least some resistance to idea bashing. The idea of the business would be to make controllable home hardware proactively available for grid balancing measures in the future when the electricity supply should be more prone to fluctuations. Previously, the problem with demand response ideas have been the high amounts of effort required in member-gathering and load reserve actualization, limiting reserve buildup and keeping profits nonexistential. The idea attempts to do its best to negate these issues.

To give the idea a bit of a background, striving for a more active end customer participation in the power market is not a new thing. It has been suggested time and again that domestic consumers should balance electricity pricing by their active market participation. These scenarios, even though they assume some activity from domestic consumers, could be realized with automatically controllable home hardware. However, what they are not able to do easily without an aid is to participate in the possibly far more rewarding grid balancing measures market, and this has its place even if the home hardware is simultaneously configured to look after the standard day-ahead power market.

The idea should probably still be shelved for some time because the leap of faith in this regard only to find out that home hardware and software is too lackluster might be too big. But considering a future of micro-generation and domestic batteries possibly, the idea is definitely somewhere on the path to that state. Also, it should be noted that public actors do have an interest to see an idea such as that realized.

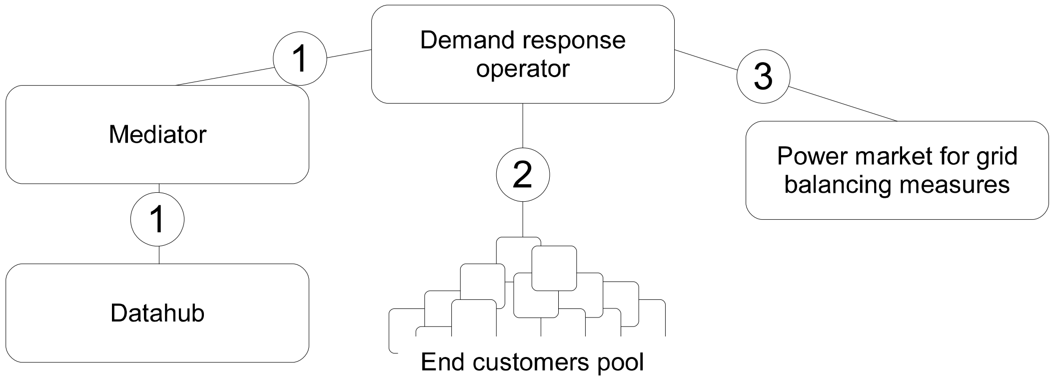

Figure 13. A largely automatized demand response operator is one of the more plausible big scenario opportunities for the future. Explanations for the numbers are in Table 8.

	Explanation
1	A demand response operator accesses Datahub via a mediator party holding data authorizations and pass-on licenses. Authorizations could possibly be included in power delivery contracts. The operator searches the data for suitable candidates with controllable home hardware, e.g., heating, air conditioning, a hot water boiler perhaps via a smart meter connection.
2	Ideally, the operator could contact suitable end customers by an effortless, automated method with an offer to join in the demand-response activity. This would require the end customer hardware control software to have a common online interface to which a required access could be given also rather effortlessly. The hardware would also have to be aware how much each of the devices connected actually consume power, so a connection to a smart meter may be required.
3	The demand-response operator makes its power cut reserve available to the imbalance power market. When offers are accepted it relays load cutting commands to its member pool. As proceeds per individual participant are very low, the operator has to consider offering some kind of a service to the participants instead of an in-cash remuneration.

Table 8. Explanations for Figure 13.

7. Discussion

Bringing smart properties into power grids, realizing demand response, and even creating an internet of things (IoT) are all examples of memes going around in the energy industry. It would not be a rare occassion to spot a topic in the TV news, suggesting, for example, how switching in more advanced metering devices would activate all of the former purposes. A claim that such a small development would lead to these huge gains. A naturally suspicious person might ask, what gains or benefits are people exactly talking about and how are they going to be achieved in practice?

Findings of this study point in the direction that all advances, after all, have humble starts and that there are no some miraculous single components that were missing before. Figure 14 is another collection of the study's results, alongside the earlier Figure 12, this time specifying more concretely what kind of aspects precede what kind of data utilization opportunities. Figure 14 depicts these potential developments on a timeline on one axis. The other axis of the figure orders the developments according to the size of the industry portion each of them concern, which is also the size of the impact each of them will have if realized. The ordering is in line with the earlier Table 7. Notable in Figure 14 is that the distance a development rectangle is from the origo should depict the likelihood it becomes a reality, this finally rounding up the industry outlook for data utilization opportunities.

One mind-boggling aspect, though this is a bit of repetition, present while doing the study was that how can people be so excited about data utilization but yet have so few ideas regarding it? I believe I found an answer to the question. It may be because the findings argue to successfully utilize data somewhere it must be accompanied with something else, or otherwise it will simply lack potential. The best example of exactly this is the case of electricity retailing where simple data utilization ideas carry nowhere, but changing circumstances might. For the rest, it was described that there are certain barriers inbetween the current states and the desired data utilization including states for firms. The answer to the former question is that a presence of obstacles or that an idea does not work in a vacuum ups the difficulty level to spot exact opportunities just that much, resulting in a bit confused state of being.

There is also something interesting solely to the industry value network picture of Figure 6. Even though it was strongly argued a strong basic understanding leads to comprehending existing opportunities, the original motivation behind creating such an illustration of the industry was that I could not find a similarly detailed picture in the literature. Now, in retrospect, it appears that industry actors do not understand so well the doings of others. For example, a metering services provider firm employees were not really aware of the functionings of the power market. They even had observed electricity generation control while a decision to produce to market was being done, but they were not able to tell what was the significance of this. That electricity generation and end customer sales are separated, organized in another manner, which totally affects the landscape for data utilization opportunities.

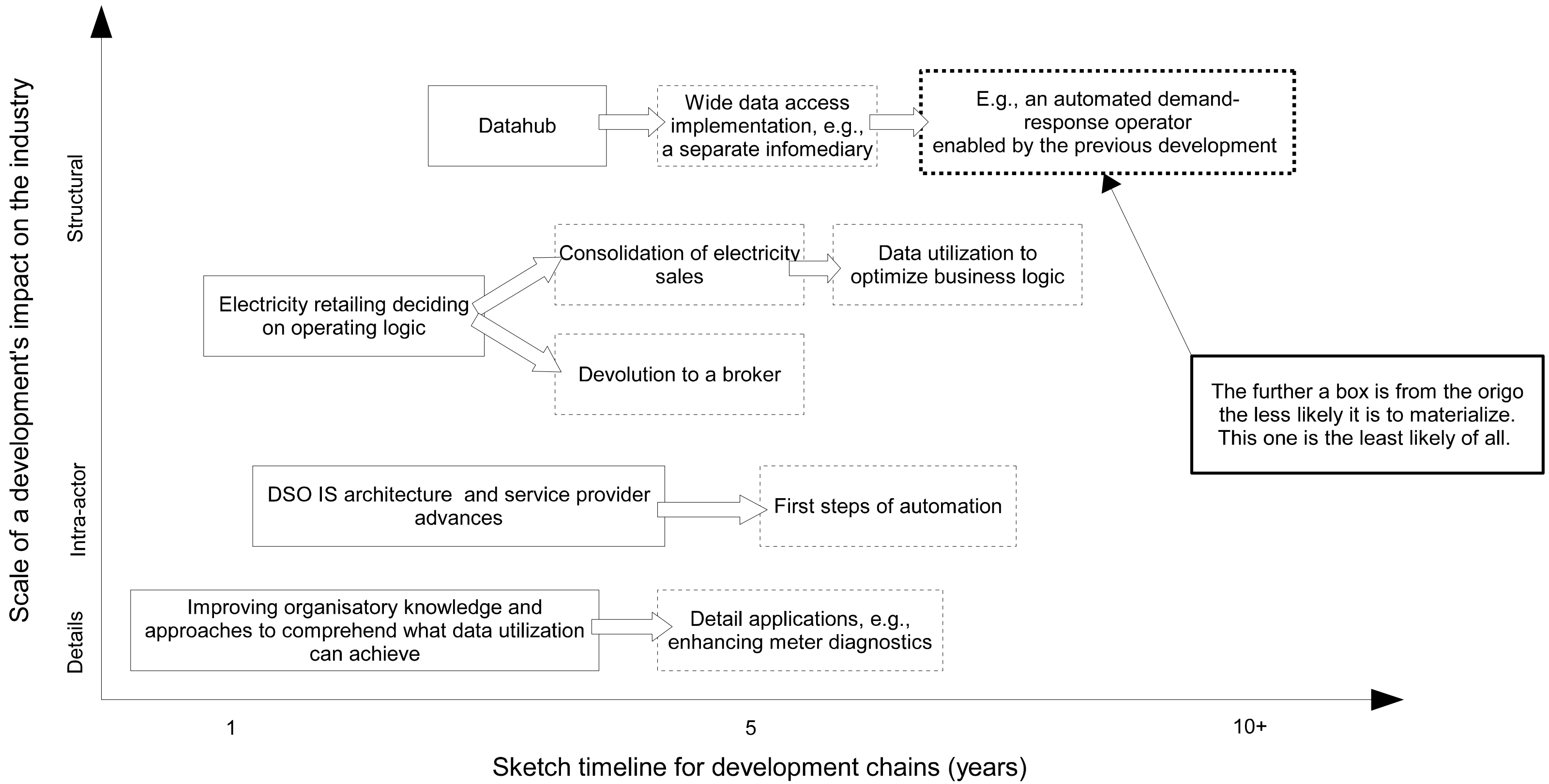

Figure 14. Study's findings put on a rather arbitrary timeline and organized according to how large industry portions they concern. The figure portrays how data utilization barrier removal result in or precede opportunities. The distance a box is from the origo can be understood to depict the likelihood it becomes a reality, shorter the distance the better.

That lack of visibility is an interesting proposition, considering how it was especially the power market dynamics that were not so well understood. Even though this is going to some length in a not so well related matter, it appears that there are simply too many similarities between the energy and the current financial industries that making a comparison between the two is something that has been coming for some time. For the financial industry, one could argue it is in their case a concept called money creation that is not thoroughly respected, if understood. The concept concerns dynamics of a system in a similar manner to that how the power market has been structured. But this is only one similarity. Another would be how there has been an increasing importance for IS and data utilization, namely, to exploit some could say deficiencies of stock markets with high-frequency trading (HFT) systems. As those systems build on a mass amount of trades, similar is not compatible with a once a day auction power market structure. But if someone is thinking about a continuous trading model they might actually be eyeing for such exotic ideas as the HFT.

The study's approach is possibly something that requires at least a bit of discussion. It might have been possible to take a more general stand, base the study on select future evolutionary paths. For example, what would more stable or unstable price of electricity mean for, e.g., electricity consumption-heavy industries? Or, what should fragmentation of the industry into micro-grids in some localities implicate? Consider how easily the first example connects actors of other industries to the energy industry. An alternative approach such as future evolutionary paths would have possibly resulted in a more visionary research paper, but one that might not be too well founded on practical realities. This can be taken as an attempt to justify the study's chosen approach.

As it stands, the study clarified the industry structure and took an interest on several aspects, themes, that play a role in data utilization opportunities. The aspects were specific, they were considered important to have laid out. Then, several opportunities, all linked to the themes, were also described. In essence, the study showed a method to make sense of "opportunities", what they are, how their existence can be estimated. A secondary outcome of the study might be as a tool to create certainty in opportunities-related discussions, which a more visionary study might have missed. Figure 15 displays these outcomes.

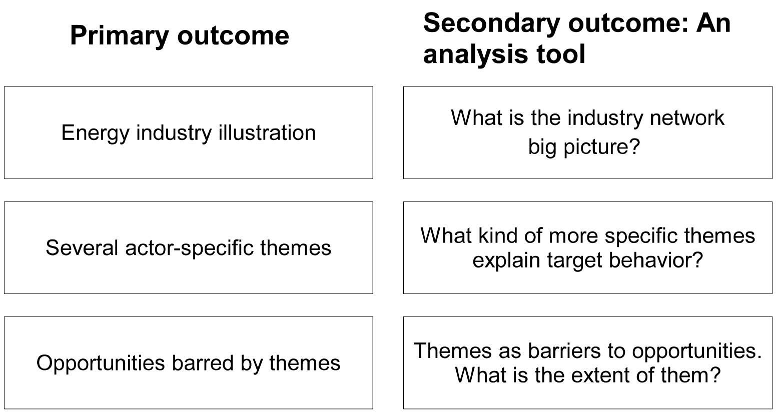

Figure 15. The study's outcomes illustrated.

8. Conclusion

The study pioneered data utilization possibilities within the Finnish energy industry. The purpose was to understand what kind of evolvements are necessitated from the various actors to bring a topic such as data analysis closer to top of their priority lists. It was found out that, for example, DSOs likely need to undergo a phase of standardization and general IS infrastructure improvement to reach the next waypoint on the way to truly figuring out their businesses. It was hypothesized that a predictive system, allowing operations nearer to limits, might be the future. But it was seen the DSOs cannot possibly succeed in doing all that alone, or in the current operating manner, enlarging the future role of IS service providers.

For electricity retailing businesses, attempts to utilize data was filled with larger questions about their future role. Considering they are being pushed against a wall, there is an incentive for them to go on the offensive with game-changing attempts to unify the sales of electricity under one roof. It was hypothesized that could lead to data analysis and optimization opportunities revealing themselves. Alternatively, if that scenario does not become a reality, it was for that reason pictured an interesting area for future business activity would be inbetween the current retailing and the power market. That would be the result of retailers' reduced role, at the same time, opening different kinds of data-related ideas to those businesses that survive the change.

More specific and simple opportunities to utilize, e.g., electricity consumption data within or even outside the industry were, however, found to be limited. There is more certainty to this the shorter the time frame one is looking at because the ideas would have to be quickly actualizable within the existing system realities. The same thinking argues why there will not be an automatic demand response system in the immediate future. Datahub was also looked at in terms of extra opportunities it might allow. The study finds that the requirement for strong authorizations, its upcoming implementation, and people's current knowledge or mindset each put a shadow on what can be done. A further information mediator may be required to control Datahub access if the want is to involve very external third parties, as was included in the demand response idea.

The above bits of knowledge were understood by the study as certain actor-specific themes that underlie their opportunities. The final industry outlook for data-related opportunities was seen to come together from composing these individual findings in a single picture. A picture that was based on earlier findings of how the industry functions and how its distinct actors function. It is interesting to note how similar a collection of themes as in the literature the study ends up with. Perhaps certain themes such as cooperation, actor roling focus, and liquefication of information resources are indeed widely useful for industry research.

For the study, understanding that when speaking of opportunities and their exploitation, what one is really talking about is how to remove existing barriers was a central notion built on the theory that proved its place. The notion allowed classifying identified barriers into those that are artificial, those that are more of a temporary nature, and those that represent the limits of minds of people or of a collective. This should help in further determining where within the industry developments can be expected and with what kind of timetables. The notion was also used in formulating a best guess of interesting future areas for data-related endeavours. To develop that a bit, RBT logic was applied on the areas to have a glance of how interesting they look in general and how incentives are divided between possible interested actors.

However, the research described definitely does not come without its own heavy faults and strings attached. Because an energy industry and data utilization are so vast concepts it should be more than likely that something important has not got the attention it deserved within the study. There had to be a limited selection of matters gone through, for example, a lot of minor data-related ideas were going around while doing the study but most of these did not have any larger purpose to serve. Then there is that what a totally different approach could have achieved and, thus, was missed. One could have visioned an utopistic future state of micro-grids and generation and figure out with the help of interviewees the kind of a role data utilization plays there.

On the other hand, that whether there should have been a drive towards listing detailed spots for data utilization, a somewhat definite answer of no crystallized during the research process. The thing is in its nascency, people are at this time eagerly looking for its potential uses, but they are nowhere near capable to actualize them. An example of which, rather unfortunately, is that there were no absolute experts of data analytics in terms of, e.g., having a PhD on the topic within the industry interviewees. Before the research, however, a couple of relevant PhD holders were discussed with to know there is not going to be something extra large missed.

A few words about concrete future research targets can be said besides the few indirect clues above. It might not be worth it to go for electricity consumption data's extra-industrial use cases in a similarly thorough and general research paper. For example, there was an attempt to reach out to Google to hear what they have to say but it appears that their efforts and interests are limited. Likewise, a similarly plausible scenario could be built that insurance businesses could have a use for the data provided by Datahub. The problem is there is not much to research there. The answer is a binary true or false, of no benefit to know which before an insurance business actually tests whether the data has predictive value or not. Considering that, perhaps future research goes further with, say, the feasibility of the scenarios listed in this study.

It might be so that the energy industry belongs to a group that has delayed information systems related gains due to complexities involved, thoroughness, and the general advancement level of systems required. That leads to question, in a positive sense, should not that mean that when these gains come, they should be that much larger? So much so that they would reason why the system is configured as it is, or put the system into another more optimized state. That should be worth the wait.

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10. Appendix A – A sample questionnaire

Disclaimer: Marko Puolakka from Granlund Consulting Oy was kind enough to give me a permission to present their interview questionnaire as a sample.

1. Granlund Consultingin toiminta ja toimenkuvasi hyvin lyhyesti.
2. Energiatehokkuus.
   - Millaisia palveluita tarjoatte ja ketkä ovat näiden palveluiden asiakkaita? Näkyvätkö sähkön vähittäiskuluttajat millään tavalla? (esim. kerrostalojen kautta?)
   - Sivuillanne kerrotte energia/kustannustehokkuuteen liittyen: "...huippuluokan simulointisovelluksia, bigdataa ja pilvilaskentaa hyödyntäen." Alueelliset energiaratkaisut? Mitä voit kertoa näistä? Eroavatko energiatehokkuuslöydökset paljonkin per kohde vai ovat samanlaisia?
   - Blogikirjoituksissasi puhut paljon asiakkaiden ajan ja vaivan säästämisestä. Voitko avata tätä, mihin asiakkaiden aikaa ja vaivaa menee?
   - Kysyntäjousto energiatehokkuussovelluksissanne? Voidaanko tätä toteuttaa / toteutetaanko tätä sovelluksenne kautta?
   - Miten nämä sovellukset/palvelut tulevat kehittymään tulevaisuudessa? Mitkä tekijät vaikuttavat kehitykseen?
3. Datahub.
   - Näkyykö datahub teille/vaikuttaako teidän toimintaanne? Datahub tuo saataville sähkönkäyttöön liittyvän datan (paikka, tehot per aika, sopimustiedotkin). Hyötyä teille?
   - Ideoita liittyen palveluihin, joille tarvetta tai joita mahdollistaa?
   - Jos esimerkiksi pohdit eri toimijoiden liiketoimintaprosesseja, niin onko näiden joukossa sellaisia, joissa olisi kehittämisen varaa ja joissa voisi hyödyntää sähkönkäyttötietoa?
4. Muutamia skenaarioita.
   - Sähkön kilpailutus ja energiatehokkuus vähittäiskuluttajien / pk-tapauksissa yhden helpon nettisovelluksen alle? Energia-alan landscape?
   - Pitkälle automatisoitu palvelu laajan kysyntäjoustoreservin kasaamiseksi sähkönkäyttö- ja muun tiedon perusteella? (muu tieto = kapasiteettipotentiaali, kohteen kyky ja halu osallistua)
   - Sähkönkäyttäjien kulutusprofiilien hyödyntäminen?
   - Tulevaisuuden skenaario: Entä jos sähkönkäytön tehomittaukset olisivat sekuntitasolla?